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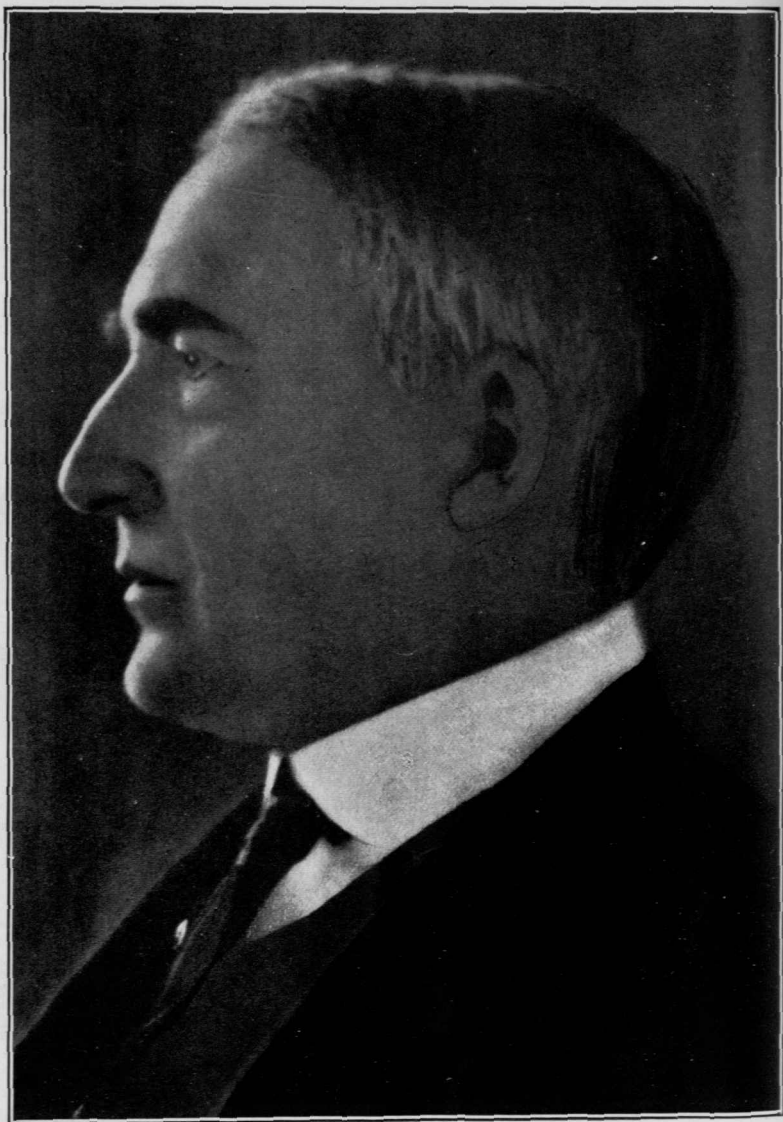
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The Mesopotamia Expedition

By Lieutenant Colonel E. S. Hartshorn, Infantry

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INTRODUCTORY: EVENTS PRECEDING THE WAR



THE political endeavors of Great Britain and Germany to obtain advantages in Mesopotamia and the region of the Persian Gulf extend back over several decades preceding the outbreak of the World War. The ramifications of these endeavors were quite extensive, and constitute an interesting epoch for the political historian. For the purposes of this study it may be stated that Great Britain had a compelling interest because:

- (a) Mesopotamia is directly upon the flank of any hostile advance upon India through Persia.
- (b) The Gulf of Persia flanks all trade routes to the British possessions in the far east and India.
- (c) With the domination of Mesopotamia went, to a certain extent, the control of the Arab nation, which had the effect of improving conditions in the vicinity of the Suez Canal and the Red Sea, both of which constituted critical points along British sea communications.
- (d) The region, although undeveloped, contained many natural resources, and was of great potential wealth.
- (e) The Persian-Mesopotamian oil fields together with the installations at the mouth of the Shatt-al-Arab represented a very considerable (British) financial investment. The product of these fields was essential to Great Britain for economic and military reasons.

Conversely, Germany sought to deny the above advantages to Great Britain for the purpose of improving her own political, economic and military situation.

Upon the outbreak of the war these political endeavors became missions for the armed forces of the contestants, resulting in a campaign which began in October of 1914 and continued until October, 1918, when the armistice between Great Britain and Turkey was entered into.

THE THEATER OF OPERATIONS

The region known as Mesopotamia (or Irak) comprises the tract in the middle and lower valleys of the Euphrates and Tigris Rivers, and extending north-west from the head of the Persian Gulf. In general it is to the east of the Arab realm, south of Kurdistan and west of Persia. The controlling geographical features are the two rivers above mentioned, adjacent to which resides a very large proportion of the population which was (1914) virtually dependent upon these waterways and their tributaries for all exterior economic necessities.

The country is exceedingly flat; Bagdad, some 700 miles from the head of the Persian Gulf by river, being but 122 feet above sea level. The natural drainage facilities are accordingly poor, and there exist many swamps of great extent, and very great difficulty of penetration. In the district of Basra, swamps extend practically across the entire region from the Persian Hills to the desert, and have the effect of restricting communications to the waterways and the narrow defile separating the swamps from the desert. This condition exists as far north as the line Amarah—Nasiriyah. To the north of this general line overland operations may be undertaken in dry weather, although movements will be influenced by the isolated swamps existing as far north as the vicinity of Bagdad.

The region is rich in natural resources, and with adequate irrigation facilities could produce much cotton, tobacco, silk and other sub-tropical products. Large reserves of oil exist, which have been developed to some extent. The region is devoid of trees, save for date palms in the southern part, and there exists practically no stone of any kind.

Viewed in a strategic sense, the region is a defile, being flanked to the east by the Pusht-i-Kuh Hills of Persia, and to the west by the Arabian and Syrian deserts. Politically, operations were at first restricted to the east by the Persian frontier. Disregarding the Persian frontier in the vicinity of the Persian Gulf, the average width of this defile, or corridor, is approximately 150 miles; its length, from the head of the Persian Gulf to Mosul (the northern limit of British advance) is approximately 550 English miles. In considering this distance, it should be borne in mind that the only means of communication available for military operations at the beginning of the campaign was the Tigris River; this is exceedingly tortuous, and served to increase the actual distances perceptibly.

From the south the region was accessible (with respect to military operations) only through Basrah, which is situated some 70 miles up the

Shatt-al-Arab from the headwaters of the Persian Gulf. At this point the channel was about one-half mile in width, and accommodating vessels drawing not more than 19 feet of water. In 1914 there were no docks, neither were there any storage or other facilities available to constitute the base for even minor military operations. Sea going vessels were unloaded in mid-stream by primitive native craft plying between ship and shore.

The Tigres was navigable as far north as Bagdad by steamers drawing not more than $3\frac{1}{2}$ feet of water. A line of river steamers was in service, Basrah—Bagdad. Navigation was exceedingly difficult because of the windings of the river previously referred to.

Communication with Persia existed in the south by means of the Karun water course and roads leading from its headwaters across the hills; to the north, the Bagdad—Kermanshah road, difficult but practicable, connected the former city with Hamadan, and from thence to the south shores of the Caspian and to Teheran.

To the north, the mountains of the Van district formed a considerable barrier, restricting communications in that direction. Bagdad was connected with Aleppo by means of a road extending along the Euphrates, and by an isolated section of the Berlin—Bagdad railway which had been completed as far north as Samarra, some 80 miles up the Tigres, from whence a road led via Mosul to Ras-el-Ain, the terminus of another completed section of the same railway extending to Aleppo. In addition to the communications along the Tigres, a road following the foothills of the Persian Mountains connected Bagdad with Mosul, where it joined the Mosul—Ras-el-Ain road to the Aleppo section of the Berlin—Bagdad Railway.

The caravan routes extending across the Arabian and Syrian deserts were impracticable for extensive military operations.

While the Euphrates did not lend itself to military operations on a large scale, it constituted a practicable route for secondary operations by troops accustomed to the region and its facilities, as did the Shatt-al-Hai which connected Kut-al-Amarah with Nasariyah.

The native population of 2,238,000 was Arab, and exceedingly unreliable.

The Persian oil fields are located in the upper valley of the Karun River which, having its source in the Pusht-i-Kuh hills, flows south-west into the Shatt-al-Arab about 25 miles south of Basrah. The pipe line of the Anglo-Persian Oil Company parallels the Karun River, terminating at the oil refining and storage plant located upon Abbadan Island at the mouth of the Shatt-al-Arab. The only settlement of consequence on the Karun River is that of Ahwaz, which is situated some 60 miles up stream, and consequently about 100 miles (by river) from Basrah.

The climate is difficult with respect to military operations. From April to September the weather is exceedingly hot, and there are many

dust storms and, at times, mirages. The flat country is susceptible to floods which have the effect of leaving the sandy loam soil in such a condition as to hinder operations materially. The mountains to the north and east have the effect of making the winters unusually cold.

THE MILITARY SITUATION

TURKISH

The region constituted the 4th Turkish Army Inspection, consisting of the XII Army Corps*, headquarters Mosul, and the XIII Army Corps, headquarters Bagdad. These corps consisted of two divisions each, and, upon the opening of the campaign, had not been brought up to war strength. An advance base was established at Bagdad, and the forces were disposed along the Tigres, Euphrates and Karun rivers. Headquarters of the 38th Turkish Division was located at Basrah; Commanding Officer, Col. Subed Bey, who was also the Military Governor of Basrah Province. To this division was attached the 23d Turkish Infantry. Strength in Basrah locality, approximately 5,000 rifles and 12 guns.

The line of communications extended up the Tigres to Bagdad, and from thence to Aleppo by the roads and isolated sections of the Bagdad-Berlin Railway referred to above. From Aleppo to Constantinople communications were by rail save for two intervals where the line crossed the Amanus and Tarsus Mountains. Here the tunnels had not been completed, and communications were by road respectively 40 and 45 miles. The distance by road from Samarra to Ras-el-Ain was approximately 300 miles. The line Bagdad—Constantinople was 1,255 miles in length, of which about 385 was by road and 867 by rail. The time consumed in Gen. Townshend's evacuation from Bagdad to Constantinople as a prisoner was 22 days. There were no delays, and the best facilities were placed at his disposal. The Tigres was used from Mosul to Bagdad for personnel and light materials, which probably had the effect of shortening the time necessary for the eastward movement.

The Turkish Army had been practically under German command for a number of years, and was organized for administration and command along German lines. Upon the entry of Turkey into the war in October, 1914, the German-Turkish high command was required to consider the following enterprises and problems which affected the strategic deployment of the Turkish Army:

- (a) The defense of the Constantinople locality (the straits)
- (b) The Caucasus frontier
- (c) The Suez Canal and the southern exit of the Red Sea
- (d) The continued domination of the Mohammedan peoples
- (e) Mesopotamia
- (f) British Indian possessions.

* The XII Corps was moved to the vicinity of Damascus incidental to, or preceding the initial concentration of the Turkish Army.

The German high command had particular interest in these matters as a means of containing the greatest possible number of Allied troops, and thus deflecting them from more important theaters of operations. Incidentally, the successful outcome of any Turkish enterprises would serve to promote the German plan for the penetration of the middle East.

The plan of the high command was as follows:

- (a) The maintenance of a sufficient force for the defence of the straits
- (b) An offensive in the Caucasus
- (c) An offensive against the Suez Canal and Egypt
- (d) The seizure of the headwaters of the Persian Gulf in force when (b) and (c) had been accomplished, and troops were available
- (e) Any operations against Indian possessions depended upon the successful outcome of the preceding enterprises, and upon the construction of practicable communications
- (f) In the meantime, the Islamic peoples were to be roused and a Holy War precipitated in the Near and Middle East Allied possessions and dependencies.

BRITISH

At the time of Turkey's entry into the war the only forces of Great Britain available for service in Mesopotamia were those of the Indian Army. This, at the outbreak of the World War, consisted of seven divisions organized and trained for savage or semi-savage warfare, and deficient in divisional artillery and the conventional administrative and supply services. There was in India practically no artillery of the Corps or Army types. The air service was virtually non-existent. The British (white) officers' corps had been greatly depleted by reason of drafts for other fronts.

The British Indian command was required to consider the following problems during the early months of the war:

- (a) The defense and internal protection of the Indian Empire
- (b) The demands of the home government for an Expeditionary Force for service in France
- (c) The same for Egypt
- (d) The same for a defensive expedition into East Africa
- (e) An expedition into Mesopotamia
- (f) The plans for basing (d) and (e) on India
- (g) The continued pacification of Islamic peoples residing adjacent to India, and to British trade routes in that vicinity.

Some years prior to the outbreak of the war the British government had established a protectorate over the provinces of Koweit and Mohammedah, thus insuring control of the headwaters of the Persian Gulf and incidentally the mouth of the Shatt-al-Arab (formed by the confluence of the Tigres and Euphrates). Bahrein Island, which is situated in the Persian Gulf some 300 miles south of the provinces

referred to above, was British owned, and so located as to flank any movements up or down the Gulf. A station ship was located in the Shatt-al-Arab in the vicinity of Basrah.

In September of 1914 the action of the Turkish Government indicated its connections with the Central Powers, and forecasted its early entry into the war. It was accordingly decided to divert a portion of the troops scheduled for France to the Persian Gulf, and on October 23d, 1914, one brigade of the 6th (Indian) Division with two mountain batteries, commanded by Brig. Gen. W. S. Delamain, arrived at Bahrein Island. The following extracts from the instructions to Gen. Delamain set forth his mission:

"The rôle assigned to your force is that of demonstrating at the head of the Persian Gulf. * * * You will occupy Abbadan Island with the object of:

- (a) Protecting the oil refineries, tanks and pipe line
- (b) Cover the landing of reinforcements, should these be required
- (c) Assure the local Arabs of our support against Turkey

* * * * *

"In the event of hostilities with Turkey, the remainder of the 6th (Poona) Division is being held in readiness to support your force, and will follow as quickly as possible.

"In the meantime you will take such military and political action as you think feasible to strengthen your position, and, if possible, occupy Basra."

The directive, following the British colonial system, contained considerable matter of a political nature, prescribing, among other things, that communication be at once established with the Shaikhs of Koweit, Muhammareh and others under British domination at the time. A political officer accompanied the expedition.

It was directed that reports be forwarded to the Chief of the General Staff, Simla. Thus the expedition was under the Indian Army command, and based on India.

The line of communications extended southeast through the Persian Gulf and the Gulf of Oman to Karachi and Bombay.

THE MESOPOTAMIAN CAMPAIGN

FIRST PHASE

OPERATIONS IN THE VICINITY OF SHATT-AL-ARAB

On November 5th, 1914, Great Britain declared war on Turkey. Two days later Gen. Delamain's command arrived off the mouth of the Shatt-al-Arab, and, after capturing the primitive defenses erected at Fao, moved up the river and occupied a position covering the installations of the Anglo-Persian Oil Co., on Abbadan Island.

Upon the declaration of war the British Captains of several of the Tigris River steamers succeeded in eluding the Turkish authorities, and were able to conceal their vessels in the lower Karun River, thus preserving them for employment in the subsequent operations.

In the meantime two additional brigades had been placed en route from India under command of Lieut. Gen. Sir A. Barrett, and, upon the

declaration of war, Basrah was definitely announced as the British objective.

Troops of the 38th Turkish Division covering Basrah occupied a defensive position at Sahil (or Zain) some 30 miles to the south, with an advance detachment at Saihan. Gen. Delamain's brigade having been reinforced by elements from Barrett's detachment, successfully attacked these positions on November 15th and 16th, the Turks suffering considerable losses at Sahil. The Turkish forces withdrew to Basrah, which was evacuated on Nov. 21st. The British pursued promptly by river and land, and occupied Basrah on Nov. 23d. By the end of November the 6th Division was concentrated at Basrah. The division was, however, without its 1st and 2d line transport, and consequently incapable of any operations at a distance from the waterways.

Upon its retirement from Basrah, the 38th Turkish Division took up a defensive position at and in the vicinity of Kurneh, some 50 miles up the Shatt-al-Arab, and at the junction of the Tigris and Euphrates Rivers. In view of the strategical importance of this locality the British, on Dec. 2d, moved against it, and after several attempts succeeded on Dec. 8th in capturing the town and a considerable number of its defenders, in all about 1,200 prisoners, including the commanding officer, Subed Bey, and 9 guns. The remainder of the Turkish garrison retired upon a fortified camp located at Rotah, about seven miles up the Tigris.

In January and February of 1915 it became apparent that Turkish forces were being concentrated at Nasariyah and Amarah for operations against Basrah and the pipe line connecting the oil fields and the refinery at Abbadan Island.

On Feb. 7th another Infantry Brigade, the 17th, arrived from India.

The Turkish authorities were exceedingly active in endeavoring to arouse a Holy War.

OPERATIONS ALONG THE KARUN RIVER

Early in February a force consisting of a considerable number of Arab auxiliaries, eight Turkish battalions and 6 to 8 guns moved eastward from the vicinity of Amarah for the purpose of cutting the pipe line in the Karun valley. Two Indian battalions with mountain guns had been dispatched from Basrah to Ahwaz for the purpose of protecting that locality, and also of supporting the Sheik of Mohammerah. On March 3d this detachment attacked the Turkish and Arab troops north of Ahwaz, and, after being rather roughly handled, withdrew to Ahwaz. Here they were reinforced by the 12th Infantry Brigade (Davison), and a defensive attitude assumed pending the arrival of additional troops from India.

EVENTS DURING THE SPRING OF 1915

During February and March the British Expeditionary Force was reinforced by the 12th Division (Gorringe), the 6th Cavalry Brigade, a

brigade (British type) of heavy artillery and some special units for administrative and supply work. The force was organized as an Army Corps, command being taken over by General Sir John Nixon on April 9th. About the same time Major General Charles V. F. Townshend assumed command of the 6th Division, relieving General Barrett.

The British were in complete control of the Shatt-al-Arab with their right flank reasonably secure by reason of the presence of the force at Ahwaz. The base at Basrah was improved to the extent possible considering available resources. Attempts were made to secure additional river transportation, since the visible amount was becoming insufficient for the demands of the expedition.

The Turkish command had concentrated a considerable force, consisting of about 20,000 Arabs, Kurds and Turks with about 15 to 20 mountain guns at Nasariyah, some 80 miles west of Kurneh on the Euphrates, and about 110 miles north-west of Basrah. The ultimate objective of this detachment was Basrah, which could be reached by the slightly higher ground to the south of the new channel of the Euphrates.

THE ACTION AT SHAIBA

The British, anticipating an advance from Nasariyah, had set up an intrenched camp at Shaiba, about 10 miles west of Basrah. This was attacked unsuccessfully by the Turks on April 12th, the latter, following their repulse, moving to a defensive position near Birjasiyah, about 10 miles south-west of Shaiba. On April 14th the British (Mellish) attacked and routed the Turkish detachment, which fell back to Khamisiyah, some 90 miles north-west. The British losses were 194 killed and 1,132 wounded; the Turkish losses were estimated as 6,000. The remnants of the Turkish force eventually withdrew to Nasariyah, where the existence of the command continued as a menace to the British left flank.

OPERATIONS ALONG THE KARUN RIVER

The detachment at Ahwaz (Davison) had in the meantime been shut up by a force of about 10,000 Arabs, eight battalions of Turks and 8 guns (Mahomed Daghestani Pasha). This force had unsuccessfully attempted to isolate the British force by means of controlling the lower Karun. On April 24th the leading troops of the 12th Division, to which was attached the 6th Cavalry Brigade (Gorringe) arrived at Ahwaz. On the same date the investing force retired to the Kharkeh River. Gorringe completed his concentration, and, on May 7th arrived in front of the Turkish position, decisively defeating the Turks who retired in the direction of Amarah, leaving small detachments in observation of the British. The British casualties were slight, and the hostile Arabs soundly punished. The operation also had the effect of containing a considerable Turkish force which would have otherwise been available for opposing Townshend's advance up the Tigres.

OPERATIONS ON THE TIGRES RIVER. OCCUPATION OF AMARAH

Since December 8th, 1914, Turkish forces had been occupying an entrenched camp at Rotah, about 6 miles north of Kurneh. This command, originally a part of the remnants of the Kurneh garrison, had been augmented, and in May, 1915, consisted of some 6 Turkish battalions, 1,800 Arab riflemen, 10 guns and the river gun boat "Marmarice," commanding officer, Halim Bey. The river between Kurneh and the camp had been mined. The river was in flood, and the Turkish position consisted of a series of isolated islands, which were held as strong points or gun positions. In view of the extent of the floods the position could not be turned, and the only solution possible was an advance by water of the attacking force.

In view of the possibility of further Turkish operations against the oil fields and pipe line, it became necessary for the British to establish themselves at Amarah from whence the movement in February had started. This mission was assigned to the 6th Division (Townshend) to which were attached 3 Navy sloops, 4 armed launches, 2 naval horse boats armed with 4.7 guns and 3 river boats as transports. On May 31st the position at Rotah (sometimes called Bahran) was successfully attacked, the garrison retiring up the river towards Amarah. The river craft and naval units pursued, arriving at Amarah on June 3d, when the Turkish forces surrendered to Gen. Townshend and a force with him of only about *30 soldiers and sailors!* On June 4th troops of the 6th Division began to arrive and took over the town. Such parts of the Turkish forces as succeeded in extricating themselves withdrew to Kut.

The British suffered 25 casualties in the capture of the Rotah position and captured 17 guns, 1,773 prisoners, 4 river steamers and a number of lighters. Immediately following the occupation of Amarah, the Tigres was reconnoitered for some 40 miles towards Kut.

This operation presents many unusual aspects, the infantry assaulting the hostile position in small native boats, some of which had been armored for the occasion. The mission of the detachment was accomplished in a brilliant and effective manner, requiring the exercise of much resourcefulness and thorough preparation.

THE ADVANCE ALONG THE EUPHRATES UPON NASARIYAH

Following the occupation of Amarah, it became necessary for the British to disperse the Turkish forces in the vicinity of Nasariyah, which now, more than ever, constituted a threat to the communications along the Tigres. The Turkish 35th Division occupied a defensive position astride the Euphrates about 5 miles south of Nasariyah with both flanks resting upon marshes. The position was organized in depth according to the conventional procedure. An advanced position covering the Gurmah Safha channel was also occupied. The Turkish

forces at Nasariyah were in communication with those at Kut by the Shatt-al-Hai, which, while not ordinarily practicable for modern craft, was sufficient for Arab means of communication.

On July 4th, 1915, troops of the 12th Division (Gorringe), together with a naval flotilla, arrived in front of the advance position, which was carried on the following day. On July 24th the main Turkish position was captured, together with over 1,000 prisoners and 17 guns. The British casualties consisted of 104 killed and 429 wounded. On July 25th Nasariyah was occupied, Turkish detachments withdrew upon Kut, where was concentrated a considerable force under Nuruddin Pasha, who had just arrived from Turkey.

OPERATIONS ALONG THE TIGRES AND CAPTURE OF KUT

Following the capture of Nasariyah, the Indian Government directed the capture and occupation of Kut for the purpose of completing British control of the Basrah Vilayet. The town is of considerable strategic importance, being situated at the point where the Shatt-al-Hai leaves the Tigres, and therefore controlling the passage to the southern parts of Mesopotamia by means of these streams. It was also the terminus of a caravan route from Bagdad.

In considering the following operations, it should be borne in mind that Basrah was still an inadequate base, and that the 6th and 12th Divisions were not provided with 2d line transport, and consequently incapable of movement away from the waterways which constituted the lines of communications and supply. The British troops had been constantly employed in field operations since the expedition arrived, and the system of replacements had been inadequate to make good the wastage. Efforts had been repeatedly made by the local command to correct these deficiencies, and to obtain more river transport which was now barely sufficient to meet the demands of the expedition.

Covering Kut towards the south were parts of the 35th, 36th and 38th Turkish Divisions, in all about 10,500 men, in an intrenched position astride the Tigres at Es Sinn; commanding officer, Nuruddin Pasha.

Following the occupation of Amarah, troops of the 6th British Division (Townshend) had continued on, and early in September the Division together with certain heavy artillery, 2 planes and 3 armed Navy launches was concentrated at Ali-al-Gharbi. On Sept. 12th, the command moved out, and, on the 28th attacked and carried the Es Sinn position, the Turkish forces withdrawing to a prepared position at Ctesiphon, some 25 miles south of Bagdad. The British troops pursued, arriving at Aziziyah on Oct. 5th. In this operation the British losses were 94 killed and 113 wounded; the Turks lost in all about 4,000, including 1,153 prisoners and 14 guns.

OPERATIONS AGAINST BAGDAD, 1915

The British maintained their position at Aziziyah, spending the following six weeks in consolidating and bringing up supplies. The Turkish command occupied this time in improving the Ctesiphon position and in completing arrangements for the concentration of their 6th Army under Nurrudin in that locality.

The operations against Kut and the subsequent pursuit of the Turkish forces had the effect of increasing the length of the British communications some 150 miles in an air line, and about twice that distance by river. Since the facilities were in no way increased, the situation with respect to communications, already bad, became acute. To add to the burdens already falling upon the supply and administrative services, the 3d and 7th (Indian) Divisions began to arrive at Basrah in November, as did a considerable number of field artillery units. Some Sanitary troops joined the expedition, but the deficiencies in administrative and supply troops increased as the expedition was reinforced.

The British force resumed its advance on November 19th, again concentrating at Laj about 15 miles south of the Turkish position. It consisted of the 6th Division plus one infantry brigade and two regiments of cavalry, now greatly depleted as to strength in all respects, and two armed launches (Townshend); combatant strength, 9,183. The troops of the 6th Turkish Army in the Ctesiphon position numbered between 11,000 and 14,000 (the minimum and maximum estimates) and from 40 to 50 guns. The position was strong, and organized in depth according to modern methods.

The British attacked on Nov. 22d, and succeeded in capturing the first line of the defenses together with some 1,300 prisoners and 8 guns. The second line was penetrated, but the Turks, having been opportunely reinforced, counterattacked, and the British were compelled to fall back to the 1st line, which was consolidated on the 23d. The Turks continued upon the offensive, but were unable to drive the British from the 1st line. On the 23d and 24th the British wounded and the Turkish prisoners captured on the 22d were evacuated upon Laj. Turkish reinforcements continued to arrive, forcing the British to retire on the 26th. The Turks pursued, but were unable materially to inconvenience the British withdrawal. A considerable rear guard action took place on Dec. 1st at Umm-al-Tubal, which was very cleverly broken off by the tactics of British cavalry, and, on Dec. 3d the 6th Division was united at Kut, which was at once prepared for defense. On Dec. 6th the cavalry brigade which had been attached to the 6th Division left Kut for the south, and on the 7th, Kut was invested by troops of the 6th Turkish Army (Nuruddin Pasha).

The British losses during the operations against Bagdad were 692 killed and 3,852 wounded, something over 35 per cent. In spite of

this, all wounded were evacuated, 1,500 Turkish prisoners brought in and no guns lost.

SECOND PHASE

OPERATIONS IN THE VICINITY OF KUT

The investing forces consisted of about 12,000 men of the 6th Turkish Army, with about 33 guns. The actual command was still exercised by Nuruddin Pasha, operations in general being directed by a German staff under Von der Goltz. A defensive position was organized and occupied at Shaikh Saad, about 30 miles down stream from the town; this was astride the Tigres and accordingly designed to prevent relief from the direction of the British base. Another position on the Wadi, about 8 miles nearer Kut was prepared; there remained also the Es Sinn position which the 6th Division had captured during the first advance upon Kut.

British advance detachments were located at Ali-al-Gharbi, about 25 miles down stream from the Turkish position at Shaikh Saad.

The paper strength of the British garrison (Townshend) on the date of investment was 8,893 combatants; there were about 800 rounds per rifle and 600 rounds per gun on hand. In addition to the divisional artillery of the 6th Division, there were a few 4.7 and 5-inch guns. There were in all 7,411 rifles. The garrison was able to repulse all Turkish attacks during the investment.

On Dec. 15, 1915, the British relief force consisting of all or parts of the 3d, 7th and 12th (Indian) Divisions, certain Air Units and Naval craft (Aylmer) was concentrating at Ali-al-Gharbi. This force moved out early in January, 1916, and on the 4th the advance detachments (Younghusband) were in contact with the Turkish troops in the Shaikh Saad position. On the 7th the main body came up and attacked; the Turks after a tenacious defense retired, Jan. 9th, up stream to the Wadi position. The British troops were spent, and the pursuit ineffective. British casualties, 4,262; Turkish, about 4,500.

The Wadi position was attacked on the 13th, the Turks withdrawing to a strong position in the Umm-al-Hannah defile. The British followed, and prepared to attack.

On Jan. 19th Sir John Nixon was superseded in command of the Expeditionary force by Sir Percy Lake, who for several years had been Chief of the General Staff in India.

The British unsuccessfully attacked the Umm-al-Hannah position on Jan. 21, but succeeded in holding their position of departure against strong Turkish counter attacks. British casualties, 2,741; Turkish, about 2,000. From Jan. 22d to Mar. 8th the British consolidated their position, brought up supplies and completed the concentration of the 3d Division. During this period the Turks withdrew to the Es Sinn position. This the British unsuccessfully attacked on Mar. 8th, later withdrawing to the Wadi and Orah.

Aylmer was relieved of command of the Tigres Corps on March 11th, and succeeded by Gorringe, who had previously been Chief of Staff of the expedition.

The 13th (British) Division (Maude) was then brought up, and on April 5th the Tigres Corps again attacked the Turks, who had moved forward and reoccupied the Umm-al-Hannah position together with one near Falahiyah. The Turks withdrew to the Sanniyat position about 14 miles downstream from Kut. This the British unsuccessfully attacked April 17-19 and again on Apr. 21-24. The Turks held, and, on April 29th, Kut capitulated after a defense of 147 days. British casualties in the efforts to relieve the garrison at Kut amounted to 21,973. The strength of the Tigres Corps on Apr. 29th was about 29,000 bayonets, 1,500 sabres and 133 guns.

EVENTS DURING THE SUMMER AND AUTUMN OF 1916

The Turkish command improved the Sanniyat position, extending it south of the Tigres and to the west across the Hai, thence to the Tigres at a point a few miles upstream from Kut. Preliminary arrangements were made for an advance down the Euphrates against the British left at Nasariyah and eventually Basrah. Von der Goltz died of spotted fever shortly before the surrender of Kut.

British communications were improved, as were the administrative and supply arrangements, including the base at Basrah. There was a thorough reorganization and reconstitution of the forces. Land transport was issued to the troops. The river transportation, heretofore inadequate, was increased up to the demands of the expedition. In July the British War Office took over the expedition from the Indian Command. Gen. Sir Percy Lake was relieved by Gen. Stanley Maude who had come out in command of the 13th Division. Secondary bases were established at Kurneh and Amarah, which were connected by a railway extending along the Tigres. Bagdad was announced as the objective of the force, which was to be attained notwithstanding any divergent operations upon the part of the Turks.

On Dec. 12th British concentrations were completed in front of the Sanniyat position, and from that date to Feb. 23d, 1917, operations were carried on against the Turkish position in front of Kut. On the latter date the British succeeded in turning the position by a movement across the Tigres to the west and north of the town. The Turks withdrew to a position on the north bank of the Dialah River, about 10 miles south of Bagdad. The British force pursued as far as Azizeh where it remained until March 4th, reorganizing and bringing up supplies. The British captured during these operations some 4,000 prisoners, 39 guns, numerous machine guns and trench mortars and many barges, lighters and stores. There were also recaptured four armed launches which had been lost during the previous advance on Bagdad.

THE OCCUPATION OF BAGDAD

On March 7th, 1917, the British advanced and unsuccessfully attacked the Dialah position. On the following day the British renewed the attack and succeeded on the 10th in expelling the Turks from their position. On March 11th Bagdad was occupied. In these operations the British employed parts of 7 divisions, approximately 100,000 men, and about 300 guns. The Turkish force consisted of about 40,000.

OPERATIONS UNDERTAKEN FOR THE PROTECTION OF BAGDAD

Upon attaining Bagdad, it devolved upon the British command to take the necessary measures for the security of that locality. Here the situation was not dominated by the rivers as in the southern districts. The terrain to the east, north and west was appropriate for mobile operations, and the command, in its movement to the north was shortening the Turkish communications while extending its own. There existed a difficult but practicable route to Persia through Pai-tak Pass, two practicable routes to Mosul (in addition to the upper Tigres) and a road to Aleppo along the Euphrates. There was also the isolated section of the Berlin-Bagdad Railway which had been completed as far north as Samarra (about 80 miles).

Operations were therefore undertaken along all of these routes.

THIRD PHASE

OPERATIONS UP THE TIGRES

Upon retiring from Bagdad, a part of the XVIII Turkish Corps fell back along the river and occupied a defensive position at Kasirin, 8 miles north of Yahudie. The British advance guard (Cobbe) continued on through Bagdad on March 11th, arriving in front of the Turkish position on the 14th. The following day the Turkish position was carried, the defenders falling back towards Mushadiya Station.

OPERATIONS UP THE DIALAH, 1917

Other Turkish troops had retired up the Dialah on the Kermanshah road establishing themselves at Bakuba, about 30 miles distant from Bagdad. Upon the date of the British occupation (March 11th) a column was moved in this direction, arriving opposite Bakuba on the 14th. On the 18th a detachment was crossed about 5 miles below the town, which was taken in reverse. The Turks fell back towards Khanikin.

At this time the Russian General Bartoff, who had defeated the Turkish XIII Corps in Persian territory was moving westward along the Kermanshah—Bagdad road in the vicinity of Kasr-i-Shirin with the intention of joining with the British in the Khanikin district. The British, moved out from Bakuba on Mar. 20th, and encountered troops of the Turkish XIII Corps at Shahroban on the 23d; these fell back to

a strong position on the Jebel Hamrin ridge, which the British attacked unsuccessfully on the 24th, retiring after a Turkish counterattack to Shahroban. On the same day British forces occupied Deltawa, about 10 miles north of Bakuba.

While these operations were in progress the Turkish XVIII Corps, which had retired to the north, advanced from the vicinity of Samarra and, moved down to the Shatt-el-Adhaim, in an attempt to extricate the XIII Corps, which was now between the Russian forces advancing from Persia and the British. The XIII Corps advanced from Kizil Robat on March 27th, and attacked the British forces at Deltawa. The British repulsed the attack, whereupon the Turks fell back on Deli Abbas pursued by British Cavalry, which contained the XIII Corps at that place. In the meantime the Turkish XVIII Corps took up a position near Himma, which is located on the Tigres about 15 miles north-west of Deltawa. This position was carried by the British on the 28th, the XVIII Corps falling back across the Shatt-el-Adhaim. At the same time the XIII Corps fell back through Kifri.

At Kizil Robat, on April 2d, the British gained contact with a small detachment of Gen. Baratoff's Russian command operating in Persia. Contact was not maintained because of the extensive communications involved, the Russian detachment returning at once to Persian territory.

Following these operations reinforcements were received by the XIII and XVIII Turkish Corps.

OPERATIONS ALONG THE EUPHRATES, 1917

From March 11th to 19th a British movement with a view to the occupation of Feluja, on the Euphrates about 40 miles west of Bagdad, was entirely successful. The occupation of this locality had the effect of covering the Aleppo road with respect to any advance upon Bagdad from that direction. It also served to deny the Euphrates to the Turks as a means of communication between upper and lower Mesopotamia.

EXTENSION OF THE NORTHERN PROTECTIVE GROUP

There remained in the vicinity of Samarra detachments of the XVIII Turkish Corps amounting to some 10,700 rifles, 700 sabres and 46 guns. This force occupied a strong defensive position with an advanced detachment located in the ruins of Istabulat. The British command needed Samarra as the northern terminus of railway, and because of the artificial installations controlling the courses of the Tigres in that vicinity. Operations against Samarra were undertaken on April 9th, but were delayed because of a demonstration against the right flank of the movement by troops of the Turkish 2d and 14th Divisions from the region of the Jebel Hamrin. On April 18th this movement was broken up, the Turkish troops being routed. The advance continued, the British capturing the advance position on the 21st, whereupon the

main position was evacuated, the Turks retiring up both sides of river. British booty consisted of 16 locomotives, 240 trucks and guns.

During the month of April the British captured more than 3,000 prisoners, and no organized Turkish units existed within 40-50 miles Bagdad by reason of their successful operations.

OPERATIONS ALONG THE EUPHRATES

The British command now turned their attention to the situation on the Euphrates, where the Turks maintained a garrison at Ramad some 30 miles up stream from the British post at Feluja. The Turkish force consisted of some 1,500 regulars with about 2,000 native auxiliaries. The British advance gained contact with this force on July 8th, and attacked on the 10th. The attack was unsuccessful, and the British withdrew to Sinn-el-Zibban on the 14th, where they remained until Sept. 26th. In the meantime reinforcements were received by the Turkish garrison. On Sept. 28th the British again attacked, sending cavalry and armored cars to the right rear of Ramadie, thus cutting the road to Aleppo; the Turks, being unable to extricate themselves, surrendered on the 29th. The British captured 3,454 prisoners, 13 guns and large quantities of munitions and stores.

CAVALRY RAID ON MENDALI

For some time the British communications had been subjected to annoyance by a small Turkish detachment located at Mendali, which is situated some 60 miles east of Bagdad at the base of the Persian Hills. This detachment was surprised by British cavalry on Sept. 29 and dispersed; incidental to the movement about 300 baggage camels were captured. The remnants of the Turkish forces escaped into Persia through the mountains.

OPERATIONS TO THE NORTH OF BAGDAD

On November 2d British forces advancing from Samarra attacked and dispersed parts of the Turkish XVIII Corps in the vicinity of Tekrit about 30 miles up the Tigris. After destroying installations and stores the British forces, on Nov. 3d, retired upon Samarra.

The ridge of Jebel Hamrin still being in possession of parts of the Turkish XIII Corps, two columns under Lt. Gen. Edgerton were moved in that direction early in December. On Dec. 3d, the British gained control of the passes, and maintained this control as necessary for future operations.

OTHER EVENTS IN 1917

During the early fall two German Divisions were moved to Aleppo with a view to their employment in an offensive in Mesopotamia, which was to be commanded by Falkenhayn. The British successes in Palestine made it necessary to divert these divisions to the south, and the offensive was not undertaken.

On Nov. 9th the British commander, General Sir Stanley Maude, died and was succeeded by Lt. Gen. Sir W. R. Marshall.

During the year the British captured 15,944 prisoners and 124 guns.

BRITISH ADVANCE ALONG THE EUPHRATES

In January and February, 1918, the Turkish forces at Hit were reinforced, and made several small demonstrations against the British troops at Ramadie. In February and early March, British troops (brooking) were concentrated in the vicinity of the latter place for an offensive up the river, the objective being Hit. The Turks retired before the British advance, and went into a defensive position at Khan Bagdadie; this was attacked by the British on March 26th, a wide flanking movement by cavalry and armored cars succeeding in reaching the rear of the Turkish position, and cutting the force off at its line of retreat along the Aleppo road. On the 28th the Turkish force surrendered, except for certain small detachments which were able to break through. These were pursued as far as Ana, and some mobile British elements proceeded on some 70 miles farther towards Aleppo. The British captured some 5,200 prisoners, and returned to Hit after completely dispersing the enemy.

OPERATIONS ALONG THE BAGDAD-MOSUL ROAD

Late in 1917 the Russian forces withdrew from Persia, thus exposing the British right flank to operations from the east through Pai-Tak Pass. In order more effectually to cover this locality, British forces moved out from the passes of the Jebel Hamrin (captured by Edgerton in December, 1917) on April 26th, and advanced along the Mosul road. The Turkish garrison at Kifri retired before this advance upon Kirkuk. On the 29th the British crossed the Ak Su River and captured Tuz Kermatli. The Turks evacuated Kirkuk, which was occupied by the British on May 7th, reconnaissance being carried on some 25 miles to the north. The British remained in the locality until May 30th removing stores from the Turkish advance base, then withdrew to Kifri, which was held for the purpose of covering the routes to Persia. In this operation the British captured about 2,000 unwounded Turks and 15 guns.

In the Euphrates River and Mosul road offensives the British captured about 7,500 prisoners and 30 guns.

Following these operations the British forces went into summer quarters, the experiences of the three preceding years strongly dictating such procedure.

OPERATIONS ON THE NORTHERN FRONT

Upon resuming operations in October 1918, contact existed in the vicinity of Tauk, on the Bagdad—Mosul road, and at Fathah, where the Tigris flows through the Jebel Namrin. The British assumed the

offensive along the Tigres on Oct. 24th, the 17th and 18th (Indiar Divisions assisted by two cavalry brigades attacking the Fathah position. This movement was timely in view of Allenby's continued advance in Palestine, and was designed to increase the difficulties already confronting the Turkish high command. As in the previous operations up the Euphrates, the mobile units succeeded in gaining the Turkish line of retreat towards Mosul. On the 25th, the Turks fell back to the line of the Lesser Zab, and on the 27th attacked the force of cavalry and armored cars which had taken up a position in the vicinity of Hurwaish. The attack was unsuccessful, and on Oct. 30th the command, consisting of the entire 14th Division and parts of the 2d and 5th Divisions, surrendered.

On the right wing, along the Mosul road, the British advanced on Oct. 18th, capturing Kirkuk after slight resistance on the 25th. The Turks withdrew to the Lesser Zab river, from whence they withdrew on the 27th in view of the plight of their forces along the Tigres.

CONCLUDING EVENTS

On November 14th the Turkish garrison at Mosul surrendered, followed shortly thereafter by the Turkish posts up the Euphrates. The armistice with Turkey had been previously signed (October 30th), at which time there existed in Mesopotamia Turkish forces capable of effective military operations.

SUBSIDIARY AND POLITICAL OPERATIONS, 1918

Upon the withdrawal of the Russian forces from Persia, small British contingents were dispatched to that country, penetrating via Kerman-shah and Hamadan as far as Enzeli on the Caspian, from whence an expedition was sent to Baku (July, 1918). The purpose of this movement was purely political; it had, however, the effect of covering the right flank of the Mesopotamia Expedition, and to that extent some military significance. Some 650 miles to the east of Enzeli, another British force was established at Meshed, with advanced detachments in occupation of important points along the Trans-Caspian Railway as far east as Merv. This latter contingent was based on India, and had no influence upon the forces in Mesopotamia other than to improve conditions on the right flank, as in the case of the Hamadan and Enzeli posts.

The political officers accompanying the expedition succeeded in peacefully penetrating several localities, notably the region of the Euphrates between the posts of the army at Feluja and Nasariyah. This had the effect of conserving the military forces for other enterprises, and of making it unnecessary for the army to undertake operations wherein the casualties from sickness alone would have been considerable.

ANALYSIS

WITH RESPECT TO THE LOCAL OPERATIONS

THE MOVEMENT OF THE EXPEDITION TO MESOPOTAMIA

The dispatching of a brigade of the 6th Division to the head of the Persian Gulf for the purpose (among other things) of establishing a bridge head, had the effect of preserving unity of command, and of placing the land operations from the start exclusively under the Indian Army command. The Royal Navy was charged with convoying the command, but furnished no troops analogous to our Marine Corps for advance base or beach operations. There was, therefore, no phase of the movement for which the Royal Navy was responsible, and consequently no necessity for a change in command and staff administration upon the arrival of contingents of the Army. The leading brigade, having established itself ashore, was reinforced by the remainder of the 6th Division, which, in turn covered the subsequent arrival of other units. There was one command and one allocation of responsibility throughout, and the troops of the Army demonstrated their ability to perform tactical landing operations in an efficient manner.

SECURITY MEASURES DURING THE EARLY PHASES

The British occupation of Ahwaz, Kurneh and later of Amarah and Nasariyah as localities covering the oil fields, together with the military base and communications, constitutes a good example of the application of the Principle of Security. All practicable routes leading to the essential localities were covered, and the primary mission of the expedition accomplished.

TRAINING AND ORGANIZATION WITH RESPECT TO LOCAL CONDITIONS

As the result of training and experience in savage and semi-savage warfare the offensive spirit was thoroughly inculcated in all ranks of the Indian Army. This existed to such an extent that the fighting qualities of the Turkish troops were, in some cases, seriously underestimated, with the result of causing the Expeditionary Force as a whole and certain detached elements to embark in enterprises wherein the successful outcome was patently impossible. (The first advance on Bagdad; Ahwaz, Mar. 3d, 1915; Ctesiphon, Nov. 22d, 1915.)

The divisional organization existing in the Indian Army, while appropriate for local and frontier operations, was not suitable for employment against the German type Turkish units. In view of the strained relations existing prior to October of 1914 with particular reference to the theater under consideration, it appears that this condition should have been anticipated, and the units provided with suitable divisional artillery together with the administrative and supply adjuncts necessary for modern warfare.

OPERATIONS AGAINST BAGDAD; FIRST ADVANCE

Efforts to discover some military justification for the first operation against Bagdad have been unsuccessful. The expeditionary force was inadequate in strength and deficient as to communications at the time this enterprise was undertaken. The attack on the Es Sinn position, and the subsequent pursuit to Aziziyah were brilliantly carried out by the troops of the 6th Division; the retreat following the unsuccessful attack upon the Ctesiphon position commands, the admiration of the military student. But the operation as a whole was ill advised, and, in view of the situation, the attainment of Bagdad and its subsequent maintenance at that time by the British was impossible. It is not the purpose of this study to attempt in any way to fix the responsibility for the initiation of this movement; it may be stated, however, that the British high authorities desired to obtain some advantage in the Near or Middle East to counteract the effects of the contemplated evacuation of the Gallipoli Peninsula, which at that time (November, 1915) had been decided upon, and further, that German propaganda announcing the completion of the Berlin—Bagdad Railway between Constantinople and Aleppo was released about the same time. (The tunnels were not completed when Gen. Townshend was evacuated to Constantinople as a prisoner several months later.)

During this phase of the operations the elements of the expedition were so dispersed, and the demands for the protection of communications were so excessive, that the application of the Principle of Mass with respect to the entire force was difficult or impossible. In the early phases this condition was compensated for to a certain extent by resorting to the Principle of Movement; the operations of the 12th Division in the vicinity of Ahwaz in May, 1915, and its subsequent transfer to the left wing for the operations against Nasariyah in July being a good example of this procedure. In view of the extent of Townshend's advance it became necessary to utilize this Division to guard the communications, and it was, therefore, not available for employment in the first operations against Bagdad. No comment appears necessary upon the subject of using combat divisions for this duty and service.

During the attempts to relieve the garrison at Kut the Principle of Mass was repeatedly violated. The first attack of the relieving force was made before the 3d Division had completed its concentration and movement up from the base, and other attacks were made before the 13th Division was brought up. The actions serve to illustrate the bad results of the "piece meal" attack quite as well as many notable meeting engagements which have gone down in history as horrible examples of this procedure. It must be stated that conditions existing in Kut were a powerful urge to the British command, but the fact remains that the

garrison did not capitulate until all of the then available combat units had been brought up the river and engaged with the Turkish forces. Had the concentration of this entire force been completed before the attack, the history of the expedition and the attendant casualty list might have been considerably different.

SECOND ADVANCE AGAINST BAGDAD

Considering these operations from a local aspect it may be stated that they were in consonance with the accepted Principles of War. Conditions improved from the date upon which the direction of the expedition was taken over by the British (home) high command. Prior to this time there had been vacillation at the top, and the local command and staff work had not, to be charitable, been good. While the local command made commendable efforts to improve administrative and supply conditions, there was not a clear cut conception as to the influence of these obvious deficiencies upon the military operations. There was too much of effort expended towards the bases (India) and too little towards the enemy.

In the preparations, the concentrations and the operations around Kut there is little to criticise from a military viewpoint. Upon the occupation of Bagdad, the Principles of Mass and Security were correctly evaluated in the dispositions; the locality was at once covered towards Persia, Mosul and Aleppo to a distance of about 45 miles, while a central mass was maintained in the vicinity of Bagdad available for employment in either of the above directions. For these dispositions Maude had all or parts of six divisions.

It is proper at this time to consider the dispositions possible had the 9,000 effectives of the 6th Division under Townshend attained Bagdad in November of 1915 with no supporting forces immediately available. The population of the city was about 250,000, it was astride the Tigris, and, as General Maude stated "very difficult to defend." In view of these subsequent events, the impossibility of Townshend maintaining his forces at Bagdad is obvious.

OPERATIONS FOLLOWING THE OCCUPATION OF BAGDAD

Following the occupation of Bagdad, there is much to be learned by the military student in the operations of both the British and Turkish forces, notwithstanding the apparently unscientific manner in which the latter was handled. The tactical methods employed by the British in the Euphrates and Tigris offensives of 1918 were most effective, and in each case the mission was accomplished in a complete and decisive manner by the capture of the bulk of the opposing forces. Whether or not the procedure would have prevailed against better troops is debatable. There was considerable tactical dispersion. The American Army, however, has an interest in small wars, and these operations are therefore

well worth our consideration from a constructive standpoint. Certainly these operations constitute excellent examples of the application of the Principle of Movement.

THE EMPLOYMENT OF THE TURKISH FORCES

The Turkish high and local commands undoubtedly had the correct appreciation of the mission of forces operating on a secondary front and in a divergent manner with respect to the main operations of the war. The admirable defensive qualifications of the Turkish soldier were fully exploited. The local command is open to criticism in a tactical sense by reason of the establishment and occupation of advanced posts (on certain occasions) in front of their main positions. Offensive operations were undertaken when British movements or dispositions seemed to give some prospect of Turkish success; otherwise the correct defensive attitude was maintained. There was sufficient activity, real and advertised, upon the part of the Turkish forces to keep whatever strength the British brought in, quite well occupied, and therefore not available for detachment to other theaters. And here it must be stated (notwithstanding exterior considerations to be later discussed) that the local Turkish command accomplished its mission, since it succeeded in containing several times its strength in British troops together with all that constitutes the requirements of modern armies with respect to munitions, supplies, facilities and means of communication.

COMMAND AND RESPONSIBILITY

From its inception until July, 1916, the expedition was under command of Headquarters of the Indian Army. Other elements of the British army operating against Turkish forces at Gallipoli, in Egypt and Arabia were directly under the British high command. During this period, therefore, operations (with respect to the British) against the Turkish Army were directed by two different commands. Broad decisions were, at times, handed down to the Indian Command by the War office, but there was no real cohesion until the expedition was taken over by the high command. This condition of affairs contributed extensively to the breaking down of the operations in the winter of 1915-16.

In addition to the division of responsibility existing in British command with respect to operations against the Turkish Army in Asia, there existed still another Allied command directing the Russian operations in the Caucasus and Persia. Admitting the natural difficulties existing with respect to communications, it appears that there were possibilities for coordinated action upon the part of the British and Russian forces. General Maude recognized this upon the occupation of Bagdad, his conception being that the British forces constituted the left flank of the Caucasus Army, the Russian Army standing in the

vicinity of Trebizoid and Erzerum forming respectively the right and center. Maude conceived that the Russian movement should continue to the west, while the British advanced up the Euphrates; thus a front extending from the Black Sea to the Syrian desert would be covered. But there is no apparent evidence of any attempt to secure unity of purpose and consequently coordinated effort. The Turks, accordingly fought on interior lines and under one command against Allied troops in the Caucasus, Mesopotamia and Palestine, each under a separate command and on exterior lines. The Allied operations were of necessity unscientific, uncoordinated and uneconomical as a consequence.

THE OPERATIONS AS RELATING TO THE PURPOSES FOR WHICH THE
CAMPAIGN WAS INITIATED

(a) *The necessity for protecting the oil industry*

This could have been accomplished by a defensive expedition occupying A marahand Nasariyah with supporting troops at Kurneh and the necessary posts in front of the oil fields, all based on Basrah. Forces necessary, not to exceed the strength of three Indian Divisions together with the necessary naval craft to preserve river communications.

(b) *Mesopotamia covers the flank of any advance on India through
Persia*

An examination of the terrain of Persia, and of the communications available to the Central Powers for an advance upon India thereby at once answers this question. The ancient armies operating over these natural routes were insignificant in strength as compared with modern armies; the individuals composing these forces fought with weapons carried by hand and lived off the country. There were accordingly no supply problems, and each man with his weapon was a self contained combat element. The operations of the Turkish, Russian and British forces in Persia prove beyond doubt that a modern army of sufficient strength to move against India would "bog down" practically before it started. The availability of the Trans-Caspian Railway to the Central Powers after the withdrawal of Russia from the war did not alter this situation; there still remained Persia and Afghanistan, devoid of communications, to be crossed before India could be reached.

(c) *Control of Islamic peoples*

Politically, this was a real problem to the Allies in general and to Great Britain in particular. The statement that Bagdad in Allied hands would solve this vastly extended problem is at once open to argument. The British defeat at Ctesiphon and the subsequent surrender at Kut did not materially affect the Mohammedan problem, or promote the efforts of the central powers to incite a Holy War. Subsequent events in Arabia indicate quite to the contrary.

Had the Central Powers been successful in their efforts, it is believed that disturbances could have been put down locally with far less military effort than was expended in securing Bagdad and in its subsequent maintenance. It would have been the old story of disciplined military forces fighting savage mobs, and there has ever been but one outcome in the end.

(d) *The Control of the Persian Gulf vital to protect trade routes*

The measures stated in (a) above solve this problem so long as the British Navy controlled the sea.

(e) *The possibility of containing forces of the Central Powers*

This will be discussed under the situation existing on all fronts.

(f) *Domination over a potentially rich territory*

This will also be discussed under the situation as a whole.

ANALYSIS WITH RESPECT TO THE SITUATION AS A WHOLE
THE MISSION OF THE ALLIES

The real mission of the Allied Powers throughout the war was the defeat of the main German Army. *All else was secondary.* There should have been massed, accordingly, for service in theaters containing the main German Army, Allied troops and resources in sufficient quantities to overthrow the former. This procedure is in accordance with military precept extending back to time immemorial. It had been the doctrine of all successful commanders.

GERMAN PRE-WAR PRINCIPLES REGARDING STRATEGIC DETACHMENTS

Prior to the war a great mass of dependable German military literature was translated into English, and made the subject of study by English speaking military persons throughout the world. In this literature the subject of strategic detachments and the Principles of Mass and the objective from the German view point were thoroughly discussed. These principles were sound in all respects, and based upon the experience of ages. The employment of minimum forces on secondary fronts and for divergent operations was the rule; the employment of masses against the hostile main army the keystone of the entire doctrine. It seems inconceivable that the British high command could, in view of these principles, visualize Germany employing considerable forces of any kind in enterprises against India or even Egypt.

COMMUNICATIONS AVAILABLE TO THE CENTRAL POWERS

Even had the German plans contemplated considerable strategic detachments, a study of the communications available for movements against India and Egypt would have at once indicated the impossibility of the movement to, and maintenance at these localities of modern armies. There was available the incomplete Berlin—Bagdad Railway

with respect to Palestine and Mesopotamia and thereafter the impossible terrain of Persia. Covering Egypt was the desert. The possibilities of the Trans-Caspian Railway have been heretofore discussed.

THE REAL PURPOSE OF THE EXPEDITION

We must, therefore, look farther for the real reason for the presence of the Expeditionary Force in Upper Mesopotamia and the ultimate occupation of Mosul. A brief digression is here necessary for the purpose of discussing political aspects. The political advantages accruing by reason of the occupation of desirable territory upon the termination of hostilities are obvious; reference at the peace table to the location of "our most advanced outposts" is very compelling after a successful campaign. We must, therefore, align the political aims of Great Britain preceding the war with the operations of the Mesopotamian Expeditionary Force. This procedure involves an analysis too extended for this paper, and not pertaining to command functions. It is sufficient to state that the political aims and military missions coincide to a marked degree. And therein lies the real reason for the extensive operations entered into, the consequent diversion of a large number of troops from more important theaters, and the expenditure of vast amounts of stores facilities and treasure vitally needed for the sustenance of the Allied peoples.

Thus the Mesopotamian Expedition constituted one of a number of divergent operations, which, aside from their respective merits, had the effect of removing from the vicinity of the main German armies some hundreds of thousands of troops and all that goes with them in the way of stores and facilities necessary for modern war. The whole political and military story concerning these detachments will probably never be told; in so far as the responsibility rests upon the Military the following statement of Napoleon is pertinent: "There are many good generals in Europe, but they see too many things; as for me I see only one: masses. I seek to destroy them, knowing well that their accessories will then fall back of their own accord."

OTHER COURSES OPEN TO ALLIED COMMAND

Let us now return to the Asian theaters of operations in the Near and Middle East. Here we find (Feb. 1st, 1918) in Palestine some 165,000 Allies contained by 51,000 Turkish and German troops, and in Mesopotamia 184,912 Allies contained by 34,510 Turkish troops. The strength varied with the different phases, but these figures suffice for this discussion. The military necessity for maintaining these Allied contingents in front of the weak Turkish detachments is not apparent. The Turk is notoriously a poor offensive fighter. Having in mind the demands of modern war, it does not appear that a materially greater Turkish strength could have been maintained with the available communications, particularly with respect to the Mesopotamia theater.

A movement against the Aleppo locality for the purpose of obstructing the Turkish communications in that vicinity might have been undertaken. This would have the effect of isolating the forces of the Central Powers in Palestine and Mesopotamia, would deny to a certain extent, intercourse between the Turks and Arabs and would have served indirectly to protect the British sea lanes. The operation would have run into large numbers of troops, and have had the effect of setting up another theater of operations in addition to the large number already existing. In view of the possibility of the employment of German units against such an enterprise, the contingent would, of necessity, have to be constituted of good troops completely equipped and munitioned for any class of operations. To embark in such an enterprise would have had the effect of aggravating the strategical dispersion already existing and of further defeating the application of the Principles of Mass and the Objective with respect to the main German Armies.

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Coats of Arms and Badges of The Coast Artillery Corps

By Colonel Robert E. Wyllie, C. A. C.



HE adoption of arms and badges for organizations of the Army was formally approved towards the end of 1919. Many years ago regiments were authorized and encouraged to obtain such insignia, but no official use was made of them, neither did the War Department exercise any control or supervision over the designs, and the result was a great variety, many defying the laws of heraldry, and a remarkable number containing historical inaccuracies.

In 1919 it was decided to use regimental arms on the colors in place of the arms of the United States, thus making the color truly regimental in character, instead of being a national emblem as it had previously been. The retention of the eagle showed the Federal nature of the organization, but the remainder of the design applied only to that particular unit.

Since then tabards for all bugles have been authorized, the design being the same as that of the approved arms, and special regimental devices are permitted to be worn on the uniform, which affords another use for the coat of arms, although they are not limited thereto. In addition there are a number of unofficial uses to which they can be put, such as on stationery, pictures, etc.

A coat of arms, in the ordinary acceptation of the phrase, consists essentially of a shield, on which are placed designs to illustrate the history of the unit. The most important accessories are the crest and motto. The crest was formerly worn on the helmet and, whenever practicable, should be so shown today. Due to the manner in which the arms and crest are placed on the regimental color, the helmet is there omitted, but on drawings, stationery, etc., it should be used to support the crest, thus avoiding the appearance of a crest suspended in midair.

The heraldic wreath typifies the torse of cloth or silk formerly used to fasten the crest to the helmet, and is always shown. It is placed between the helmet and the crest, or as the support of the crest if the helmet is omitted.

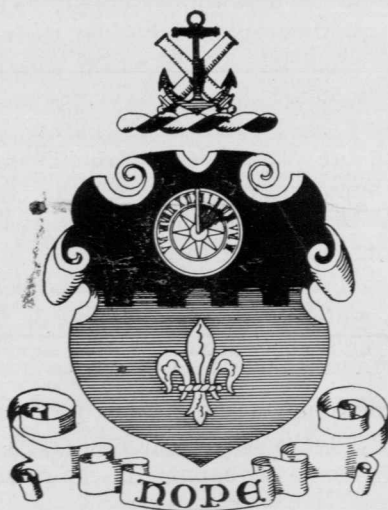
The mantling is an accessory of the helmet. It symbolizes the mantle formerly worn over the knight's armor, and is always the principal color of the shield, lined with the principal metal; and the same rule holds true for the wreath.



COAST DEFENSES OF PORTLAND



COAST DEFENSES OF BOSTON



COAST DEFENSES OF NARRAGANSETT BAY



COAST DEFENSES OF LONG ISLAND SOUND

The motto is placed on a scroll or ribbon, usually below the shield, but occasionally elsewhere, there being no fixed rule. If the motto has a specific reference to the crest, it is better placed above. Sometimes it is between the shield and the crest, as for example in the arms of the United States; or again it may be on a belt or ribbon encircling the shield. Neither is there any rule for the colors of the scroll and motto, but the best result will generally be obtained by using the same as for the wreath and mantling.

Supporters are accessories not officially recognized by the War Department, but authorized for use unofficially, provided they are appropriate to the particular unit. Supporters are figures placed with the apparent purpose of holding up or supporting the shield, the eagle as an example, supports the arms of the United States; Great Britain uses a lion on one side and a unicorn on the other. In personal arms supporters are authorized only for peers, but this rule does not hold in the case of impersonal arms such as for regiments. The use of soldiers in the uniform of the Revolution as supporters would be appropriate only for a regiment which took part in that war. Crossed cannon, sabres, etc., are suitable in their respective arms; guidons with appropriate design are now available to all. An alligator might well be used as a supporter by a regiment which was in the Seminole War, an Indian for a regiment in any Indian campaign; the Chinese dragon for one in the Relief Expedition of 1900, etc.

The arms, crest, motto and supporters were, in the old days, strictly personal, and could not be used outside of the family. To distinguish the retainers and soldiers of any particular person or family, a badge was worn somewhere on the clothing. This badge was frequently the family crest (omitting the wreath); sometimes a design taken from the shield was used, or a supporter of the arms, and occasionally the badge was evolved entirely independently of the arms. The regimental insignia authorized by par. 46, A.R. 600-40 is this old custom in a new form, and when so worn should be called a badge, even though it may be the entire regimental arms.

In a few cases regiments have adopted badges instead of coats of arms, in which case it appears on the colors, as well as on the uniform.

For the *Coast Defenses of Portland* the shield is divided horizontally, the upper half red, the lower silver. On the red is a silver star of five points, and on the lower half is a pine tree in natural colors. The star has a double significance; it symbolizes the Pole Star, this being the most northerly defense on the Atlantic Coast, while its five points represent the five forts, Williams, McKinley, Levett, Preble and Baldwin. This star is placed on a background of artillery red. The pine tree is the old emblem of the State of Maine, and appears on the coat of arms of that State. The crest is a phoenix, and is taken from the arms of the city of Portland, whose history it well typifies. That city

has been destroyed three times by fire, in 1676 by the Indians, in 1690 by the French and Indians and in 1775 through a bombardment by the British. In 1866 one-third of the city was wiped out by flames. Each time however Portland has risen from its ashes to a more prosperous existence, like the phoenix of old. This legendary bird has been much used in heraldry, and it is so well known that a recital of its meaning is unnecessary, although some historical data may be interesting. The legend was given by Herodotus, Ovid and Pliny as being ancient in their times, and it probably originated in Egypt, long before the dawn of history. The phoenix is also known in China and Japan, being second only to the dragon in their mythology, and with attributes very similar to the classical legend. The phoenix has been used as a personal device by a number of famous people, among whom may be mentioned Queen Elizabeth of England; Mary, Queen of Scots and her mother, Mary of Lorraine; Jane Seymour and her son, Edward VI. Subsequent writers and artists have used it as a device for Joan of Arc.

Heraldically the phoenix is always represented as an eagle rising from flames, and in medieval times was generally colored in gold and either red, blue or purple. In this case the body and head are purple, the wings gold. The flames are always shown in natural colors.

The motto for these defenses is *Terrae Portam Defendamus*, the translation being "We defend the land gate (or port)." *Defendamus* is the motto of the Coast Artillery School, and *Terrae Portam* is a Latin rendering of Portland.

If a badge for the uniform is desired, nothing could be better than the phoenix.

Boston and vicinity is rich in historical lore, but probably no incident which occurred there is as important as the landing of the Mayflower at Plymouth. Certainly this is characteristic of the neighborhood, and it has been selected as the motive for the arms of the Coast Defenses, a shield of artillery red, on which is the Mayflower under full sail in the natural colors. The crest consists of a wreath of the colors on which is a dexter arm embowed habited gray with white ruff grasping a staff with the flag of Bunker Hill attached all proper. The motto is *Prima Libertatio Acie*, (in the first line of battle for liberty.)

Newport is another place which has many early associations and the arms of the *Coast Defenses of Narragansett Bay* well symbolize its history. The shield is red on the upper half for artillery, and blue below taken from the arms of Rhode Island, which has a gold anchor on a blue shield. The dividing line between these two colors is embattled to show fortifications. On the red is the gold sundial-compass of Roger Williams (Date 1638) the founder of the Colony of Rhode Island and Providence Plantations. In the lower half is a gold fleur-de-lis, to commemorate the services of the French during the Revolution, when

their fleet, under the Chevalier de Ternay (who is buried at Newport) manned and operated the harbor defenses against a British attack.

The crest is two gold crossed cannons supporting the anchor of Rhode Island in blue. The motto of the state, *Hope*, is also used by the Coast Defenses. The crest would make an excellent badge for wear on the uniform.

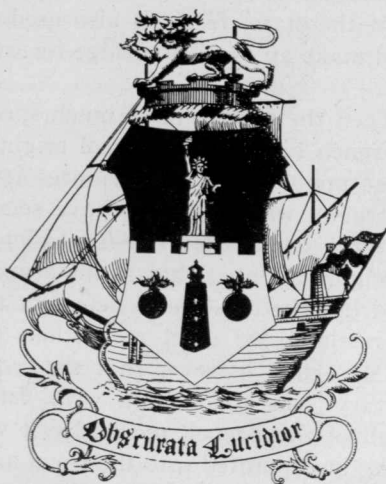
Probably no heraldic device has been the subject of so much speculation as the *fleur-de-lis* of the old French kings, but the real origin of it still remains unknown. The most popular legend attributes it to Clovis, King of the Franks (5th century), who is said to have seen a banner in the sky on which were three golden *fleurs-de-lis*. Victory followed this vision, and Clovis thereupon adopted that as his arms to replace the three toads which he had inherited. A fatal defect in this legend is that heraldic arms were not adopted until more than 600 years after the death of Clovis. It is certain however that the crown of King Robert of France (10th century) was ornamented with *fleurs-de-lis*, and from that time to the fall of the French monarchy it was the royal device of the kingdom, being incorporated into the royal arms in the reign of Louis VII, about 1150.

The anchor, the device of Rhode Island, is the symbol of stability.

For the *Coast Defenses of Long Island Sound* the shield is gold, and bears a blue diagonal stripe, known as a bend, on which are three silver towers. The bend with its towers represents the line of three forts, Wright, Michie and Terry, placed diagonally across the entrance of the Sound. On each side of the bend is a narrow parallel stripe of black, symbolizing the iron defenses. The crest is the head of a fish hawk in natural colors, which bird abounds in that vicinity. The motto is a command to the enemy, *Stop*. A suitable badge for these defenses is the shield in its entirety.

The bend as an heraldic device is said to have originated in the scarf or baldric often worn as a mark of knighthood, over one shoulder and under the other arm. This led to its being considered as symbolic of a commander or leader. There is no historical warrant however for this origin and it is much more likely to have been at first merely a piece placed diagonally across the shield to strengthen it, and then specially colored for the decorative effect.

The *Coast Defenses of Sandy Hook* has a shield of artillery red on the upper half and gold below, the line between the two being embattled. On the red and rising out of the embattlements is the Statue of Liberty in gold, and in the lower half is the Sandy Hook lighthouse placed between two bursting shells. The lighthouse and shells are black, while the flames from the shells are in the natural color of fire. The Statue of Liberty is self-explanatory. The Sandy Hook lighthouse was built in 1754 and was the first on the American coast. During the Revolution one John Conoon was the keeper of the light and he per-



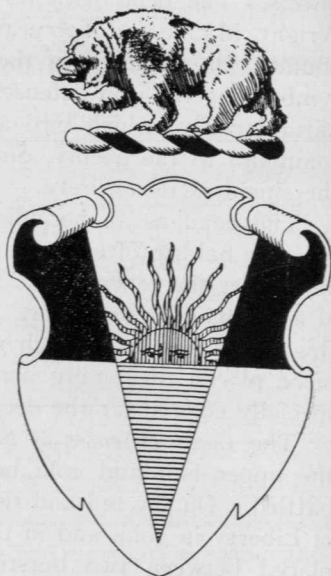
COAST DEFENSES OF SANDY HOOK



COAST DEFENSES OF CHESAPEAKE BAY



COAST DEFENSES OF PENSACOLA



COAST DEFENSES OF SAN FRANCISCO

formed his part in the cause of liberty by deliberately putting his light out of commission when the British fleet conveying General Clinton's troops was attempting to enter the harbor. This delayed the British and it is commemorated in these arms by using a darkened lighthouse, that is one which omits the customary rays of light emanating from the lantern. The bursting shells constitute a reminder of the Ordnance Proving Grounds which were located at Sandy Hook long before the present fortifications were constructed.

The crest is a gold panther, breathing fire, placed on the battlements of a red tower. The panther has long been the symbol of quickness and ferocity, and is here used to typify the power and alertness of the defenses. It is always shown in heraldry with smoke and flames issuing from its mouth and nostrils, but the origin of this conception of a panther is unknown. The panther was one of the badges of the Lancastrian party in the Wars of the Roses, and was also the personal device of the famous Marshal de Lautrec, Constable of France in the 16th century.

The motto of these defenses is *Obscurata lucidior*, and refers to the incident when the darkening of the lighthouse furthered the light of liberty in the country. A supporter for these arms to be used in all cases except on the colors has been approved by the War Department, one of the very few cases of this character. When Hudson explored New York Bay and the river which bears his name in 1609, his ship, the "Half Moon," was anchored in the Horse-shoe near Sandy Hook, in commemoration of which the shield of these defenses is displayed in front of the "Half Moon." This kind of supporter is very unusual, in fact the writer is aware of only one similar case in the entire range of heraldry, viz., the Scotch family of Campbell, which always displays their shield in front of an ancient sailing galley, or lymphad.

There are several excellent possibilities for a badge for this command, (1) the crest, (2) the darkened lighthouse with a scroll bearing the motto (3) the entire shield with its supporter, or (4) the supporter alone placed on a button. Any one of these would make a good and appropriate device to wear on the uniform.

The shield of the *Coast Defenses of Chesapeake Bay* has for its base the arms of Lord Delaware, the first Governor of the Colony of Virginia, who met and turned back the departing colonists at the mouth of the James River in 1610, thereby saving the colony. His arms consisted of a silver shield bearing a jagged black stripe placed horizontally across the centre, known to heralds as a fess dancetty. To this is added a red cross, symbolic of the landing of the first settlers at Cape Henry in 1607, their first act being to erect a cross and offer thanks for their safe arrival.

The crest is a hand in a gauntlet of silver mail grasping a gold trident, which commemorates the battle between the Monitor and the Merrimac in Hampton Roads, the first conflict between ironclads, which type of

vessels at once became supreme in naval warfare. The mailed hand grasping the trident of Neptune, the god of the seas, fittingly symbolizes that Supremacy.

The motto is *Portam Primam Defendo* (I defend the first gateway) with special reference of course to the approaches to Washington, Baltimore, and other important centres lying at the head of Chesapeake Bay. The crest would make an excellent badge.

The arms of the *Coast Defenses of Pensacola* is based entirely on the defense of Fort Pickens during the Civil War. That fortification was the only place within the territorial boundaries of the Confederacy over which the Stars and Stripes flew during the whole of the Civil War. This was a specially meritorious incident and the War Department has commemorated it by departing from their rule of prohibiting any organization from using any part of the United States coat of arms. This command has been permitted to use the eagle in gold on a shield of artillery red. The crest is an arm clothed in Union blue, while a gold flaming torch of liberty is held erect in the hand. The motto is *Fides ultra finem* (Faithfulness beyond the end). For a badge it is recommended that the gold eagle be used, encircled by a belt of Artillery red, inscribed with the motto in gold lettering and having an Artillery belt plate at the bottom of Civil War design.

Volumes could be written about the eagle in heraldry. A bas-relief from Chaldea, having an approximate date of 4000 B.C., is in the Louvre and is the most ancient heraldic representation now extant; (the word "heraldic" being used in this case as synonymous with "symbolic".) The relief shows an eagle with outspread wings, grasping in its talons the backs of the two lions, which are endeavoring to bite the feathers of their captor. This symbolized victory over two enemies, and ever since that time the eagle has been the emblem of power and dominion, and the correspondence and other records preceding its adoption on the United States arms show that the same idea was uppermost in the minds of the designers.

Arms for the *Coast Defenses of Los Angeles* have not yet been approved.

The *Coast Defenses of San Francisco* have a shield of purple on the upper half, with gold below. On this is a charge known in heraldry as a pile, an inverted triangle having the base coincident with the top line of the shield and the apex very near the bottom. The upper half of the pile is gold, the lower blue. In the center of the pile is a red demi-sun. This combination represents the setting sun seen through the Golden Gate of San Francisco Harbor.

The crest is a grizzly bear, the emblem of California, in black. No motto has yet been adopted. Probably the best design for a badge would be a combination of crest and shield, the grizzly bear placed in front of the setting sun.

The pile is a very old heraldic device and of disputed origin. It has been said to represent a stake such as used in the construction of old fortifications, or the point of a spear or javelin. It will be observed that the pile gives a tri-parted shield, and one school of heralds held this way was emblematic of the Trinity. The word itself comes from the Latin *pilum*, which was used to denote a military official somewhat akin to the modern Colonel.

The *Coast Defenses of Puget Sound* has a shield of artillery red and on it are five horizontal stripes of gold. At each side of the shield is a semi-circular piece (flaunch) of ermine. Ermine is represented in heraldry by black tails, very much conventionalized, on a white or silver background, and in this case it recalls the fur trade of the early days around Astoria, and the positions of the ermine on the shield indicate the straits across which are placed five fortifications which bar the way to an invader. (The stripes are called "bars" in heraldry.) The red is not only for artillery, but, in connection with the gold of the bars, commemorates the Spaniard who discovered the Straits in question.

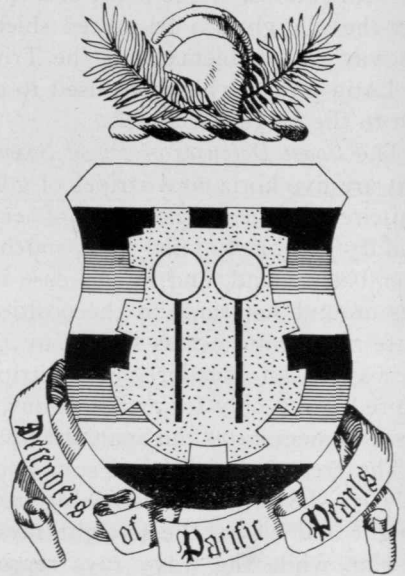
The crest is a full-faced sun, known as a "sun-in-splendor." This is always shown with rays issuing from the entire perimeter, alternately straight and wavy, the straight rays denoting the light received from the sun, while the wavy rays represent the heat. A human face is depicted on the sun itself. This was the crest of Lieutenant Peter Puget, Royal Navy, one of Captain Vancouver's officers, for whom the Sound was named. No motto has been selected for these defenses. The sun-in-splendor would make an excellent badge for this command.

Ermine has long been used to symbolize purity and loyalty, the old legends stating that the animal known as an ermine was clean to a fault, as it would permit itself to be captured rather than in any way defile its skin. To surround the hiding place of an ermine with mud was therefore believed to be a sure way of taking it, the equivalent of putting salt on a bird's tail. Ermine is always used by royalty for robes of state and its most famous example in a coat of arms is the shield of Brittany, which is simply ermine, without any device or charge upon it, and the legends accounting for this bearing are almost without number.

The *Coast Defenses of Cristobal* has a shield of artillery red, and in the centre a medieval vessel known as a caraval in gold. In the upper corner is a silver portcullis, the barred gateway used in the middle ages at the entrance of castles. The red and gold together again make the Spanish colors to commemorate the discoverers of this part of the continent. It was in 1502 that Columbus skirted this coast and landed near the Chagres River, which is indicated by the caraval. The portcullis is symbolical of the canal, which when open forms a passage between the two oceans, but when closed by these defenses bars the way to the enemy.



COAST DEFENSES OF PUGET SOUND



COAST DEFENSES OF PEARL HARBOR



COAST DEFENSES OF BALBOA



COAST DEFENSES OF CRISTOBAL

The crest of this command is unique, the arm of a pirate, tattooed with skull and crossbones, having on the upper arm a sleeve of white and green, with crimson cuff and gold buttons; the hand brandishing a pirate's cutlass in black. This recalls the days of the buccaneers who infested the Spanish Main in the 16th and 17th centuries; two expeditions in particular were made in this region, Porto Bello and vicinity being captured and raided in 1601 and 1688.

The motto is *Nullius pavit occursum* (He fears no encounter) and can be considered as referring both to the old buccaneers and to the present defenders of the canal.

For a badge to wear on the uniform the crest might be used or the gold caravel placed in front of a red portcullis.

The portcullis is comparatively infrequent in heraldry, probably the best known example of its use is that of the Beaufort family, descended from John of Gaunt, the fourth son of Edward III of England. This family used the portcullis as a badge, and it became one of the royal badges on the accession of Henry VII, who was descended maternally from the Beauforts.

The *Coast Defenses of Balboa* has a red shield. On it is a gold chevron sprinkled with red hearts. Above the chevron are two portcullises in gold and below is an old type gold cannon, placed vertically and on its summit a garland of Holy Ghost orchids. The gold and red of the chevron form the Spanish colors. The hearts are in allusion to Amador, the principal fort of these defenses, named after the first President of Panama. The portcullis has the same significance as in the arms of the Coast Defenses of Cristobal, two are used in this case to represent the two sets of locks at the Pacific end of the canal. The cannon is for artillery, and its garland is formed of orchids which are said to grow only on the Isthmus.

The word "chevron" is French for "rafter," but whether the name is responsible for the shape of the device or vice versa is unknown. It has long been employed as an insignia of military rank and in the early days of the American army was thus used for officers as well as for non-commissioned officers, which custom is still in force for cadet officers.

Like the crest of its neighbor at the Atlantic end of the canal, that of these defenses is based on the old buccaneers; an arm in a blue rolled up sleeve, tattooed on the forearm with skull and crossbones, and holding a smoking pistol of 17th century type. The most noteworthy incident of this character pertaining to the Pacific coast was the capture and sack of old Panama in 1671 by Sir Henry Morgan, the most famous of the "gentleman pirates" of those stirring days.

The motto of the command is *Strength, Loyalty, Valor*. A suitable badge would be the crest encircled by a garland of Holy Ghost orchids.

Until March, 1921, there was but one coast defense command in Hawaii, known as the Coast Defenses of Oahu, but it was then split

into the *Coast Defenses of Pearl Harbor* and of *Honolulu*. The arms of these two are designed to show their common origin. In each case the shield is gold, surrounded by a border of eight horizontal stripes (or bars), silver, red, blue, silver, red, blue, silver, red, commencing at the top. The interior line of the border is embattled to show fortifications. The eight stripes are taken from the old Hawaiian flag and arms and signify the eight islands of the group. The *Coast Defenses of Pearl Harbor* has two upright black sticks, each surmounted by a silver ball, placed on the gold. These are known as tabu sticks, and were formerly placed in front of the entrance to the king's palace, etc., every-behind the sticks being "tabu" to the common man. Similarly all behind these defenses is "tabu" to the enemy.

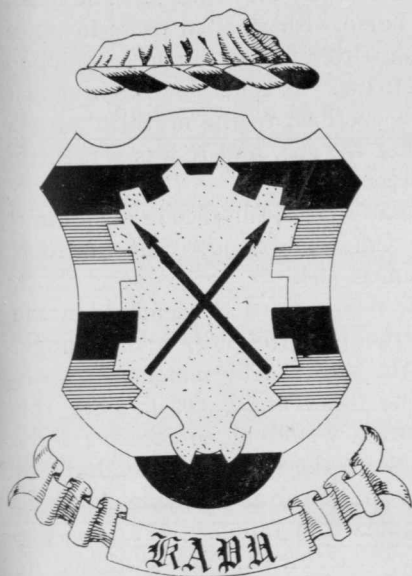
In place of these tabu sticks the Coast Defenses of Honolulu uses two ancient Hawaiian spears, crossed like the letter "X," red in color. Crossed spears were used in the old times immediately at the door of the King's tent. Both the tabu sticks and the crossed spears were on the royal arms of Hawaii.

The crest of the Coast Defenses of Pearl Harbor is the Helmet of King Kamehameha the Great in red and gold, placed on a garland of palm branches. The principal fort of these defenses is named after that monarch, while red and yellow were the royal colors. The palm branches symbolize victory. The motto is "*Defenders of Pacific Pearls.*"

Diamond Head, known by reputation all over the world, is used as a crest by the *Coast Defenses of Honolulu*, in red to denote both artillery and the color of the soil at Fort Ruger, which post is located at that famous extinct volcano. The motto is the well known Hawaiian word *Kapu*, which means "Keep out." It is extensively used in the Islands as a warning to trespassers, and these defenses employ it as a warning to the enemy.

The Coast Defenses of Honolulu has adopted their shield as a badge for wear on the uniform. For the Coast Defenses of Pearl Harbor the crest would probably make the best badge.

The shield for the *Coast Defenses of Manila and Subic Bays* is based on the arms of the Philippine Islands, although different meanings are attached to the devices used. The arms of the Philippines are red in the upper half, blue in the lower. On the red is the Spanish castle in gold, below is a silver seahorse grasping a sword. The whole is set upon the shield of the United States, so that the latter forms a border. These defenses omit the border and have reversed the shield, putting the blue on top, and separating the blue and red by a wavy line, the heraldic way of indicating water, which, in this case, consists of the two bays defended. The seahorse in the upper half is denuded of his sword and represents the island of Caballo, on which Fort Hughes is located. The castle below represents Corregidor, or Fort Mills, the principal fortification, and it is placed between two croziers of gold, symbolizing



COAST DEFENSES OF HONOLULU



COAST DEFENSES OF MANILA AND SUBIC BAYS



41ST ARTILLERY



51ST ARTILLERY

the monk (El Fraile, Fort Drum) and the nun (La Monja) of the old legend, familiar to all who have served in Manila.

The seahorse is one of the mythical creatures of heraldry. The head, neck and forequarters are those of a horse with webbed paws in place of hoofs; it has the hinder parts of a fish with a fish's tail and a scalloped fin down the neck and back in lieu of a mane. It is nearly always shown "erect." The origin of this creature is ascribed to the mythical steeds which drew the chariot of Neptune over the sea, and it was a favorite device of maritime cities in ancient Greece.

The crest of these defenses is a carabao's head, full face in the natural colors, and represents Fort Frank on Carabao Island. The motto is *Corregidor omnia vigilat* (Corregidor guards all).

These arms are so complete in their reference to all elements of the defenses that it is difficult to separate them for the purpose of a badge, so probably it would be best to use the entire achievement for wear on the uniform, but this will have the disadvantage of making the devices very small. A possible separation would be to consider only Corregidor and Caballo, forming as they do the main defense, and use a seahorse placed on the battlements of the tower as the badge.

The 41st Artillery (Railway) was organized in January, 1922, by the transfer of the 55th and 159th Companies, C. A. C., then stationed in the Coast Defenses of Honolulu. The 55th Co. was originally Battery I, 5th Artillery, and as such took part in all the principal campaigns of the Army of the Potomac from 1862 to 1864, during which time it was in both the 5th and 2d Army Corps. The 159th Co. had no war experience.

The shield for this battalion is red for artillery, and bears a diagonal stripe (bend) which is colored like the Hawaiian flag with eight horizontal bars of silver, red and blue alternately, as already described under the Coast Defenses of Pearl Harbor. Above the bend is a cross of the kind popularly known as a Maltese cross, but which has the heraldic name of cross patée, derived from the Latin *pateo*, to spread. Below the bend is a three-leaved shamrock. Both these devices are in silver. These were the badges of the 5th and 2d Army Corps in the Civil War, respectively.

The crest is an epi, or railroad track, shaped approximately like a horseshoe, encircling two Hawaiian spears, crossed like the letter "X." The epi of course refers to the railway feature of the organization, the rails are black, the crossties red. The spears, which are red with gold points (the old royal colors of Hawaii) have a double significance. Taken in connection with the epi, they show the fighting character of this railway unit, and, being taken from the arms of the Coast Defenses of Honolulu, they indicate the organization from which came the two batteries of the battalion.

The motto is *Mutamus Temporibus* (we change with the times),

referring to the fact that these two batteries have been successively armed with the latest developments of artillery, and will continue to keep up with improvements. The crest might well be used as a badge.

The *51st Artillery* (motorized) was the second organization in the Army to have its arms approved by the War Department, the date being February 5th, 1920. The regiment was organized at Fort Adams in 1917, by combining existing companies of Coast Artillery for service in France. It was at the front in the province of Lorraine in both the St. Mihiel and Meuse-Argonne operations. The shield is artillery red. Service in Lorraine is shown by a gold bend (diagonal stripe) taken from the arms of that province. On the bend is a green caterpillar to symbolize the tractor. In France this regiment marked its transportation with a device consisting of a camouflaged gun drawn by a green caterpillar.

Battery "A" was formerly Battery "A" of the old 1st Artillery and took part in the War of 1812. The crest commemorates this by using a red lion's face. The organization of the regiment for service in France is shown by a gold *fleur-de-lis* piercing the lion's face. This method of combining a *fleur-de-lis* with a lion's face is known in heraldry as a lion's face *jessant-de-lis*, and is a very old device of uncertain origin, however its meaning in this case is plain.

The motto is *En Avant*. Caterpillars might well be used as supporters for the shield. A modification of the shield has been adopted as a badge for the uniform.

The *52d Artillery* (Railway) was organized at the same time and place and under the same conditions as the 51st. Its first service under fire was in the Champagne and it was later in both the St. Mihiel and Meuse-Argonne offensives. Like the 51st, its shield is red with a gold bend for Lorraine, but the edges of the bend are formed in a manner known in heraldry as *potenté*, for Champagne, the arms of that province having a bend of that character.

The crest is a red locomotive head on, with the numeral "52" in gold on a number plate. The motto is *Semper Paratus* (Always prepared). The crest will make a good badge, but in order to clearly show the artillery character of the regiment it might be well to place the locomotive in front of two gold crossed cannon.

The *55th Artillery* (motorized) has adopted a badge in lieu of a coat of arms. On the regimental standard it is placed above the eagle's head, the breast of the eagle, where the shield ordinarily appears, being filled in with feathers. This is the only Coast Artillery Unit which has followed this plan. The same badge is worn on the uniforms. It consists of a red triangle in outline, point up, with a gold centre. On the gold is placed the figure "55," resting thereon is a caterpillar, both in artillery red. Above the caterpillar is the French map symbol to denote a G.P.F. position, the gun with which this regiment is armed.



52ND ARTILLERY



55TH ARTILLERY



59TH ARTILLERY



61ST ARTILLERY

This symbol is a black ball with a vertical arrow on top having two barbs. On the base line of the triangle is the regimental motto *Vigilantia*. This regiment was formed from both Regular and National Guard companies, half of the original organization coming from the old 1st Massachusetts Heavy Artillery which saw active service many times in the last century. "*Vigilantia*" was the motto of that regiment. The caterpillar of course has the same significance as with the 51st Artillery.

The *59th Artillery* (motorized) was organized in January, 1918, from both Regular and National Guard companies. The shield is divided horizontally, the upper part being colored blue and white in the manner known as "*vair*" in heraldry. *Vair* is a fur and represents the bluish-white skin of a species of squirrel called a *varus*. In this case it is taken from the arms of the Coast Defenses of Southern New York, where the regiment was formed. The lower part of the shield has a thistle in natural colors on a silver background for Lorraine, the thistle being one of the old emblems of that province, and is to indicate the first engagement of the regiment at St. Mihiel.

The crest is a red demi-lion, grasping in one paw a gold sword. This is taken from the arms of St. Menehould, near which place the regiment was in action supporting the 28th and 77th Divisions in the Meuse-Argonne offensive. The motto is the same as that of the Coast Artillery School, *Defendamus* (We defend).

For a badge it is recommended that the crest be used. For supporters the regiment might well take the rampant lion of St. Menehould on one side and the beaver of New York on the other. The beaver was on the original arms of New Netherlands in the 17th century and still remains on the Seal of New York City, so its use as a supporter for the 59th Artillery will show the origin of seventy-five per cent of the regiment.

The *60th Artillery* (antiaircraft) has only recently been organized and has not yet adopted arms.

The *61st Artillery* (antiaircraft) has resorted to Grecian mythology for its inspiration. The shield is silver and black horizontally, the dividing line being deeply indented (*dancetty*). This is taken from the arms of the Coast Defenses of Chesapeake Bay, where the battalion was formed and is still stationed, and has the added symbolism of showing that antiaircraft artillery is needed both day and night. On the centre of the shield is a sun-in-splendor (see Coast Defenses of Puget Sound) surrounded by the winged fellow of a wheel. Piercing the sun is a bolt of lightning. The thunderbolt and sun are gold, while the winged fellow is counterchanged, i.e., black on the silver background and vice versa. This symbolizes the story of Phaeton the son of Helios (the sun), who one day obtained permission to drive his father's winged chariot across the sky. But he was unequal to the task and Zeus brought him down with a bolt of lightning, the first recorded hit against an aerial target.



62ND ARTILLERY



63RD ARTILLERY



64TH ARTILLERY

The crest is a gold eagle's head from the arms of President Monroe, for whom Fort Monroe is named. The motto is *Non est ad astra mollis e terris via* (The way to the stars is not easy). For a badge the charge appearing on the shield has been adopted, the sun-in-splendor surrounded by the winged felloe and pierced by the thunderbolt.

The 62nd Artillery (antiaircraft) has recently been expanded from a battalion to a regiment and now includes the oldest unit in the regular army, Alexander Hamilton's battery organized in 1775. Batteries of the 62nd have taken part in six wars and this is shown by a division of the shield into six sectors, known heraldically as gyrons, alternately blue and buff, these colors being taken from the uniform worn by Hamilton's battery in the Revolution. The edges of the gyrons are embattled, which is most unusual, the writer being aware of only one other case in heraldry where the edges of gyrons are other than straight lines, that one being a junior branch of the Campbell family, where the edges are escalloped (engrailed). On the shield is a circle of 13 stars of silver, taken from the American flag as it existed in Hamilton's time, being the second exception in favor of a Coast Artillery organization to the War Department rule prohibiting the use of any part of the American flag or arms. One more exception has been made, the 3rd Infantry, the oldest regiment in the regular army, which encloses its shield in a border of the United States, i.e., the shield is surrounded by a border consisting of the silver and red stripes and the blue top of the well known United States shield.

The crest of the 62nd Artillery is a blue cross, shaped like the letter "X," edged in silver. On the arms of the cross are placed two silver arrows, and in front of all is a brass bugle with red cord entwined with a green serpent. This is to show the remaining wars, the cross is from the Confederate flag, the arrows for two Indian campaigns, while the bugle with serpent is for the Mexican War service of the 62nd's band. The sixth war, the Philippine Insurrection, is not shown.

The motto is *Primus inter pares* (First among equals). For a badge the shield has been taken, although instead of being shield-shaped, circular would be better like a button.

The gyron as an heraldic device originated in Spain, and, while not infrequent elsewhere, is most common in Spain. The name is derived from a Spanish word meaning a gore or gusset, and tradition ascribes its origin to the time of Alphonso VI of Castile (11th century) who, in battle against the Moors, was in great danger until rescued by Don Roderico de Cisneros, who cut three triangular pieces from the King's mantle as mementos of the occasion, and thereafter bore them on his arms, changing his name at the same time to Giron.

The 63rd Artillery (antiaircraft) formed and stationed at Fort Winfield Scott, California, has a purple shield and on it a gold pile. This is taken from the arms of the Coast Defenses of San Francisco. Three

winged rounds of antiaircraft ammunition complete the shield, the centre one is purple on the gold pile, the other two are gold on the purple background.

The crest is a bent arm holding a broken red lance, which was the crest of General Winfield Scott, for whom the fort was named. The motto, *Amor Patriae*, is also the motto of the Scott family. The shield would probably make the best badge for wear on the uniform.

The *64th Artillery* (antiaircraft) was formed and is stationed in Hawaii. The shield is artillery red and on it is a smaller shield carrying the eight horizontal bars of the Hawaiian flag and arms. The crest is a round of antiaircraft artillery ammunition in red with gold wings. The motto, *We aim high*, is peculiarly appropriate for an antiaircraft unit. The crest is used as a badge for wear on the uniform.

This completes the list of Coast Artillery commands of the regular army on an active status.

FROM MAINE TO MANILA

THE COAST ARTILLERY

LIVES UP TO ITS TRADITIONS

Preparation and Adjustment of Fire Against Naval Targets

A Report of the Coast Artillery Board

Editor's Note. The JOURNAL is fortunate in being able to present for the consideration of the Coast Artillery Corps the following report which represents the present status of thought concerning the all-important subject of Coast Artillery fire at moving targets, so far as the Coast Artillery Board is concerned. The Report itself is prefaced by the complete quotation of the letter from the Chief of Coast Artillery which authorizes the publication of the Report.

WAR DEPARTMENT

OFFICE OF THE CHIEF OF COAST ARTILLERY

WASHINGTON

June 27, 1923.

Subject: Publication of Report of Coast Artillery Board.

To: The Editor, Coast Artillery Journal, Fort Monroe, Va.

By direction of the Chief of Coast Artillery, I am sending you herewith a report of the Coast Artillery Board with his authorization and request that it be published as early as practicable in the JOURNAL. The object of the publication of the report at this time is set forth in the last paragraph of the report.

It is not to be understood that the authorization to publish the report carries with it approval by the Chief of Coast Artillery of all statements made therein. He is of the opinion, however, that the Coast Artillery at large will find interest in reading it. In general, the line of thought is in accord with the views of this office. In one respect it is necessary to state now and definitely a divergent opinion.

Airplane spotting should not now be considered any more of an emergency method than are any of the other approved methods of spotting. While corrections made from observation of the fall of shots may be impracticable or impossible in many battle situations, it is essential that training in time of peace be such that in battle a battery commander may take advantage of any proper method of adjusting his fire which existing conditions permit. Furthermore, co-operation between the Air Service and the Coast Artillery is so essential that every opportunity for combining the activities of the two services should be utilized, to the end that the means and methods by which that cooperation is to be brought about may be developed to the fullest possible extent. This is true even under conditions which, in war, would not appear to demand the use of aircraft.

For the Chief of Coast Artillery:

(Sgd) H. C. BARNES,

Executive Assistant.

PROCEEDINGS OF COAST ARTILLERY BOARD

PROJECT No. 114

PREPARATION AND ADJUSTMENT OF FIRE AGAINST
NAVAL TARGETS

Fort Monroe, Virginia, May 28, 1923.

Present:

Colonel H. J. Hatch, C. A. C.

Major R. B. Colton, C. A. C.

Major J. B. Gillespie, Ord. Dept.

1st Lieut. L. W. Jefferson, C. A. C.

1st Lieut. J. F. Stiley, C. A. C.

1st Lieut. J. J. Johnson, C. A. C.

Note:—This project originated with the Coast Artillery Board and will be carried as a continuing project. Further reports will be rendered whenever methods are developed which appear to warrant special consideration. The following discussion referring to certain phases of artillery fire at moving targets represents the opinions of members of the Coast Artillery Board present for duty and Major Welshmer (sick in hospital.)

1. *Our Artillery experience during the war* having been limited to the use of mobile cannon against fixed targets, contributed little toward development of improved methods for firing at moving targets.

2. *Certain deficiencies* in our present accepted methods in the conduct of fire at moving targets have resulted from an erroneous conception of the employment of shore guns against ships as a special case of field artillery firing.

3. *The difference in the fixed target problem and that of targets moving rapidly*, possibly on irregular courses with the probability that they will remain within our field of fire for a very limited period of time, is imperfectly understood or is lost sight of. Reliance upon the methods for adjustment of fire practiced in land firing would waste a considerable portion if not all of the period during which an enemy will offer himself as a target, even assuming the very improbable condition that observation of fire against naval craft in action will be practicable. If a so-called "adjustment" be obtained at all by the application of flat range corrections, it will last but a very short time due to change in position of the target, if it be maneuvering rapidly. That is, if exactly the proper correction to place the center of impact on the target be determined at any particular range, it will be incorrect for any other range. The proper correction will vary approximately as the range varies.

4. *Preliminary training and target practice too frequently assume* conditions of visibility which will permit of observation of fire, whereas

such favorable conditions should be anticipated as the exception rather than the rule, in action. The probability that enemy targets will protect themselves by dense smoke screens warns of the danger of dependence on methods of 'adjusting fire' which, while applicable to land firing or against towed targets, may be and very likely will be impracticable in action. Smoke screens which may not prevent continuous or occasional observations on the upper works or masts of vessels may effectively obscure splashes in the neighboring water area.

Training which results in a thorough understanding of the various problems of fire at moving targets with fixed and mobile artillery will require relatively little amplification to prepare for land firing. This fact was very well illustrated by the facility with which efficient Coast Artillery officers adapted themselves to the artillery problems in France.

Training must provide methods for meeting every situation which may reasonably be expected to arise in action. Target practice which does not simulate conditions of equal or greater difficulty than those probable to an action fails of its object. The assumption that continuous observation of fire to permit determination of either the sense or the magnitude of the deviations of all, or even a major portion of shots or salvos fired during an engagement will be possible, is as unwarranted as it is common. That conditions which will permit sensing but prohibit spotting will exist frequently is too generally assumed. Ordinarily fire at floating targets under simulated fire or actual service conditions is so much more of a problem than fire at land targets, that the attention devoted to the latter in the training of mobile artillery is disproportionately large.

5. *Definitions and terms* used in reference to coast defense firing should be strictly applicable to that class of fire. For example: "*Improvement Fire*" as a separate phase of fire at moving targets is misleading. There should be no distinction between improvement fire and "*Fire for Effect*" since the latter is "improved" whenever sufficient evidence is obtained to warrant corrections. "*Trial elevation*" as the mean of two elevations differing by one "Fork" is confusing when applied to guns whose elevation is given in terms of range and is changing continuously and rapidly. "*The Bracketing Method*" as defined in Gunnery for Heavy Artillery (Provisional) and Field Artillery Firing is not applicable to fire at marine targets. It is slow and wasteful of ammunition. If it be argued that it is suitable for the smaller calibers because of the relatively higher rate of fire and cheaper ammunition, it should be remembered that the normal targets of rapid fire guns are capable of extremely rapid maneuvering. Take for example such a target coming in at the rate of 1,000 yards per minute (a speed well within the maximum speed of present day destroyers and the latest designed battle cruisers.) Consider how far it would advance before

a satisfactory bracket could be established following the prescribed methods—that is, before there could be any real expectancy of a hit. Assuming that exactly the proper range correction to place the center of impact on the target is determined by this method, make an estimate of how many shots could be fired before that correction becomes ineffective due to change of range of the target. Adjustment to the expected range, that is, adjustment on the set-forward point is not practicable with the bracketing method. Whenever continuous ranges can be determined by the use either of a self-contained range finder or a long horizontal base line, more rapid and much more precise methods of conducting fire are practicable. “Emergency Conditions” which do not admit of “Precision Methods,” must be met by “Emergency Methods.” Certain of these methods partake of the nature of the bracketing adjustment but the dissimilarity is sufficient to warrant the use of a different term, to avoid misunderstanding.

6. *Fire control methods* should be such that the attainable rate of fire is dependent only on the time necessary for the mechanical operation of loading and pointing. Such of the fire control operations as are performed prior to each shot or salvo must be completed and information delivered to the guns in time to avoid waiting for firing data. In other words the rate of aimed fire should not be appreciably slower than would be required for the same gun crew in unaimed fire. The rate should in no way affect the accuracy of fire.

The fire control operations for adjustment of fire should conform to the following requirements:

a. Ballistic corrections applied for every commensurable influence which will affect the flight of the projectile.

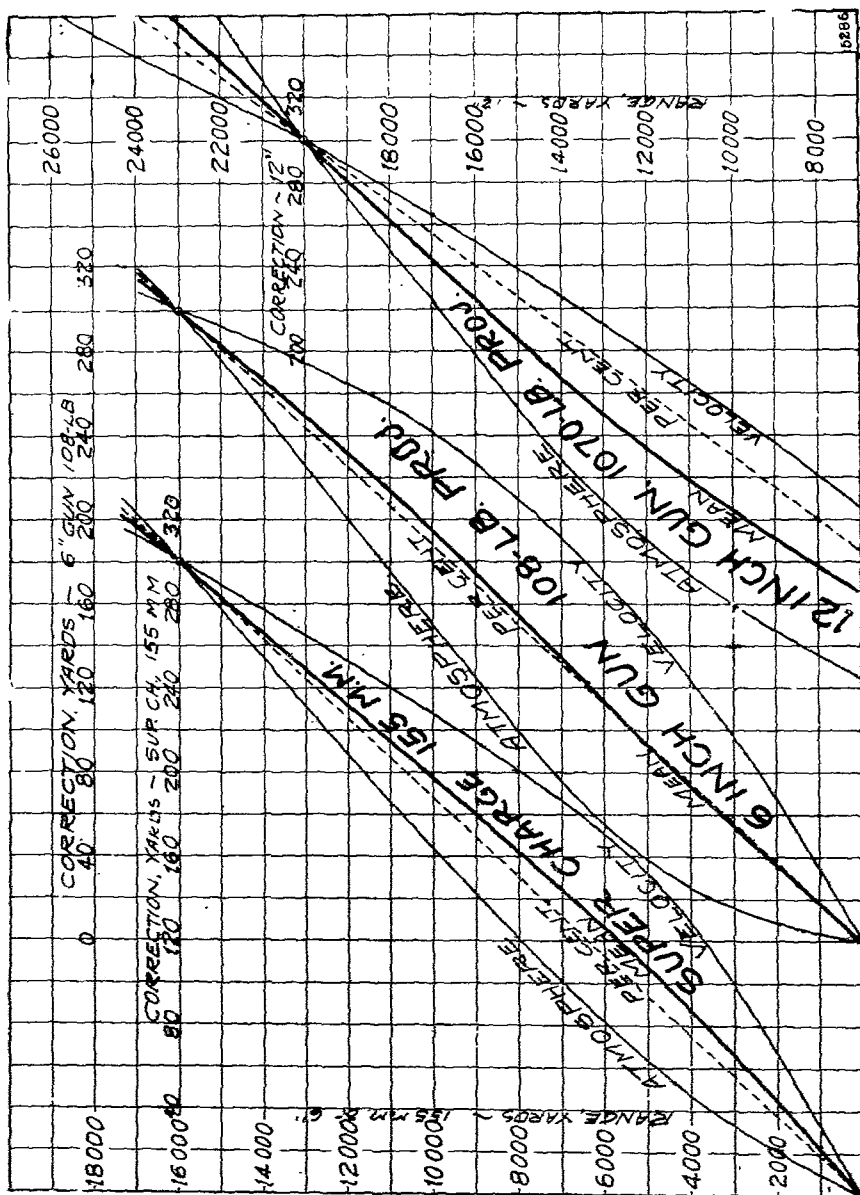
b. Arbitrary corrections determined from observation of fire applied in such a manner that they will vary for the changing ranges approximately at the same rate as the algebraic sum of the ballistic correction varies, arbitrary corrections being regarded simply as correction or changes in the ballistic correction. This will result in an automatic adjustment of the total correction to conform approximately to changes in range.

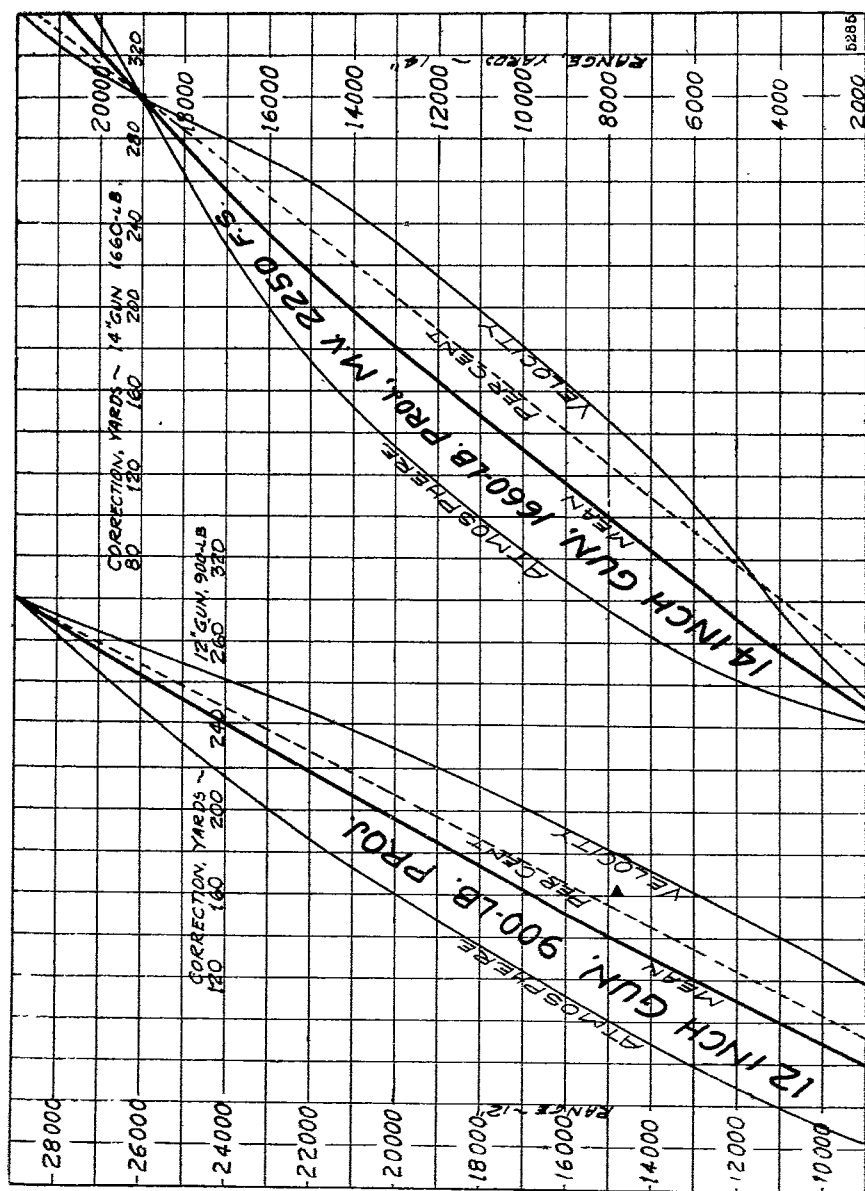
7. *Adjustment fire* should be regarded as *preparatory fire* for the purpose of adjusting the ballistic correction to cause it to compensate more nearly for observed deviations of the center of impact from the expected range. Adjustment fire is necessary because of the omissions and inaccuracies in the assumptions and computations involved in the determination of the ballistic correction. The total ballistic correction varies with varying ranges, therefore an adjustment of assumed ballistic conditions to cause the ballistic correction to compensate for observed deviations is favored rather than a range adjustment. The rate of variation of the adjusted ballistic correction will depend on the estimated

or adjusted ballistic conditions, but may be assumed to be approximately correct through a wide variation in range, during which observation of fire may be impossible. A flat correction is applicable to the range only for which determined; consequently range adjustments by the application of flat corrections are dependent on continuous observation of fire. Adjustment fire may be by single piece or by battery salvo and may be directed either at a fixed point (registration fire or trial shots) or at the target (ranging fire). While these terms refer to *fire of preparation*, the adjustment or improvement of the correction should continue throughout fire for effect if observation of fire be possible.

8. *The ballistic correction* requires but slight adjustment when the initial velocity and atmospheric conditions are measured under proving ground conditions. Improved meteorological equipment permits increased accuracy in determining atmospheric conditions, but since devices for measuring muzzle velocity have not been perfected for issue to batteries, the estimate of this element of the ballistic correction is based on very uncertain data. The practice of ascribing the difference between the observed range and the expected range of a group of trial shots as due chiefly to the difference between the assumed velocity and the actual muzzle velocity is warranted on the assumption that errors and omissions in determining the factors which affect retardation are fewer and less in amount than those which affect muzzle velocity. The rates at which a correction applied to muzzle velocity and to density of the atmosphere will vary are indicated in Figures 1 and 2.

9. *Registration fire* (trial shots) should be the method of preparatory adjustment whenever visibility conditions in the vicinity of the target, from any cause are such that shots directed at the target probably could not be observed (deviations measured), providing a "Registration Point" can be selected such that deviations can be determined. Three or more shots should be fired, ordinarily with the same laying, without reference to time interval indicators and as rapidly as possible consistent with precise laying. If because of lack of information concerning the powder, or if for other reasons wide deviations are anticipated, the second and such subsequent shots as may appear desirable may be delayed for observation of the preceding shot or shots in order that corrections, designed to bring the range of the center of impact nearer to the expected range may be applied. Ordinarily, however, such delays during registration fire should be unnecessary and are undesirable because of the time involved. When the series is completed and the mean of the range and azimuth deviations determined, fire should be shifted promptly to the target and battery fire for effect opened. The interval between the conclusion of registration fire and fire for effect should not greatly exceed one minute plus the time of flight in the case of 12-inch mortars and should be less with more rapid firing arma-





ment. Registration is favored for the preparatory phase of night firing whether smoke screens are employed by the enemy or not, since splashes are more likely to fall within the searchlight beam when the latter is stationary than when following a moving target. It is a satisfactory method whenever it can be used. Errors in laying are less likely and determination of deviations probably more certain and accurate when all trial shots are fired with the same elevation and azimuth.

Trial shots are fired and the results utilized in various ways. A very general failure to use them to the best advantage has caused them to be regarded with disfavor until they are commonly referred to as "*A method of adjustment of fire*" instead of "*The method of preparation of fire.*"

10. *The Registration Point* preferably should be on the predicted course of an enemy target at the approximate range at which it is expected to open fire and enough in advance of it so that registration can be completed one or two minutes before the arrival of the target near the point. If the target is preceded by destroyers laying down smoke screens, the registration point should be a sufficient distance ahead of them to avoid obscuration of impacts from observing stations. For registration, when employed in target practice, the same principles apply except that safety to the towing vessel should have prior consideration over the advantage gained by selecting a point dangerously near the range and azimuth at which fire for effect will be opened.

11. *Ranging Fire* (trial shots at the target), by single piece, alternate pieces, or battery salvos should be authorized (not required) when deviations of impacts in the vicinity of the target can be determined. It has the advantage of avoiding the delay of shifting fire and of offering the possibility of hits during adjustment fire. It should be continuous that is, there should be no delays, ordinarily, for observation of splashes. Adjustment corrections may be by successive approximations or be based on the mean of the deviation of three or more shots. In the former case the correction based on the deviation of the first shot might not be applied earlier than the 4th shot but as a rule should get in on the 3d shot; that for the second shot on the 4th shot, etc. After three or four shots have been observed, additional correction should be based on the mean of the deviations *from the expected range* of the three or four most recent shots or salvos, whether adjustment fire be continued or battery fire for effect opened.

12. *Fire for Effect* normally should be by battery and should follow adjustment fire without unnecessary delay. If adjustment fire be by ranging shots there should be no interval between the two classes of fire. Corrections throughout fire for effect should be based on the mean deviation of the most recent shots or salvos. This may be done conveniently by the use of a graphical record of deviations.

A chart and sliding scale may be constructed to show the successive impacts plotted on a vertical time scale in such a manner that the horizontal scale will indicate the relative range deviations measured from the successive positions of the target or set-forward point as an origin. This will enable a correction to compensate for the deviation of the center of impact of the more recent shots to be determined by a visual inspection of the plot, that is, the correction scale will show the correction in yards necessary to bring the center of density of recent splashes to the origin representing the target, or set-forward point. *It is important that the shot to which each correction was applied be indicated on the record.* Such a device was designed and used by Lieut. Colonel J. B. Murphy, C. A. C., at Fort Eustis, Virginia, very satisfactorily. A modification of Colonel Murphy's device is being studied with a view to recommending its adoption as part of the fire control equipment of all batteries.

In the case in which the magnitude of range deviations cannot be determined owing to failure of communication with a flank observing station or for other cause, but visibility is such that the sense of deviations of line shots may be determined, the most probable position of the center of impact with *respect to the target* may be determined by observing the relative frequency of shorts and overs and applying a correction based upon the method described in par. 44, Training Regulations, No. 430-85, Field Artillery Firing. For any particular gun the probable errors of which are known, a table may be constructed to show for different ranges the probable deviation of the center of impact from the target for different proportions of shorts and overs. Shots which are not in line with the target as viewed from the battery can not be sensed with accuracy.

If changes in the meteorological conditions, especially changes in the longitudinal wind component, be noted and corresponding corrections applied promptly, changes in the ballistic correction as adjusted by recent registration fire will be small and infrequent.

13. *Observation of fire* is an important aid to accuracy of fire but reasonably effective fire is possible without it. Proper equipment and a well organized and properly instructed spotting section can furnish information of the magnitude of deviations of splashes which can be observed from a well located flank station, with the required accuracy and within a few seconds after the splash. Ordinarily, when sensing of shots is possible, measurement of deviations should be possible also. How frequently in action either will be possible is a matter of conjecture but it certainly is fair to expect that ships in attempting to pass fortifications would protect themselves with smoke screens which would obscure practically all splashes, either short or over, except perhaps the abnormally short shots. For example, a fleet attempting to gain en-

trance to Chesapeake Bay: a successful runby would enable it to get beyond the range of the fixed defenses. Smoke screens would partially conceal its movements and wholly prevent observation of fire from Fort Story. The masts and parts of the upperworks of ships may be visible above a smoke screen sufficiently to permit fairly satisfactory tracking. It is true that the smoke screen hampers the fire of the ships it protects but under conditions similar to those at the entrance of Chesapeake Bay it is probable that fleet would accept that handicap willingly, since it could not hope to damage the fortifications seriously during the short period it would expect to be under fire. The fleet commander would rely for his security on the speed of his ships and the protection of the smoke screens, rather than on his own fire.

Haze or low-lying fog will produce similar conditions. No method of conduct of fire is sound which is solely dependent on continuous or even frequent observation of splashes, and consequently on the absence of smoke screen or fog.

14. *Percentage corrections* or corrections which vary directly as the range varies may be used in lieu of corrections applied to velocity or to retardation effects, and are as convenient to apply as flat corrections. The true rate at which a correction should increase or decrease with increasing or decreasing range, to compensate accurately at different ranges for errors in determining the ballistic correction, can be determined exactly neither from the velocity curves nor from the retardation curves on the Pratt range board. The proper curves probably would lie somewhere between them. The curves shown in Figures 1 and 2 indicate that a percentage correction will not vary materially from either.

This method of applying corrections is especially applicable to rapid fire batteries or batteries not provided with Pratt range boards, but may be used conveniently and advantageously with any batteries. The total *correction* may be determined from the Pratt range board instead of the *corrected range*. This combined with the total correction determined from observation of fire and applied as a percentage correction will vary for different ranges, approximately as the total ballistic correction varies, so long as there is no change in meteorological conditions.

The operation of the Pratt range board therefore may be deliberate without causing delay in delivery of data at the emplacement. The operator should check his result frequently but the percentage correction would change only when there is a change in meteorological conditions or a change of several thousands yards in range.

15. *A Percentage Correction Device* may be constructed by making a logarithmic scale of ranges, along which a correction scale carrying a "Set" pointer and a "Read" pointer may be moved. The graduations of the correction scale should be equicrescent, and represent percentages.

If desired, two correction scales may be used, one superimposed on the other in such a manner that the ballistic correction as determined from the Pratt range board will be shown on one and the correction as determined from observation of fire on the other, the distance between the "Set" and "Read" pointers as read on the logarithmic range scale being the total correction in yards. This device is being tested with a view to recommendation for its adoption as part of the fire control equipment of all batteries. In the meantime blueprints of logarithmic range scales will be furnished on application to the Coast Artillery Board.

16. *The Setforward Point* in the case of a ship following a zig-zag or sinuous course may be located considerably off the course actually taken by the target. This may occur also, due to inaccuracies in plotting. Corrections therefore should be based on deviations from the range and azimuth of the set-forward point. If range deviations are observed from the target, deviation from the range of the set-forward point or expected range may be determined by requiring the plotter to call out the range deviation of the set-forward point from the plot of the course of the target, and by combining this result algebraically with the deviation of the splash from the target, as determined by the spotting section. This method has been used successfully and compares favorably in speed and accuracy with spotting methods which determine the deviation from the set-forward point directly.

17. *The fire of the minor caliber armament* should be regulated in accordance with the same principles and by similar methods as with the larger calibers. It is probable that targets will be more numerous and maneuver more rapidly, which will increase the uncertainty of identifying them by distant spotting stations. Usually, ranges can be determined at frequent intervals by a self-contained range finder located near the battery, and range corrections applied through a percentage range correction device with or without a Pratt Range Board. *A varying correction which adjusts automatically the range correction to the rapidly varying ranges is of equal or greater importance than for batteries of the primary armament.* Such a correction is approximately compensating over wide variations in range whereas a flat correction is not. The process of determining the total range correction should be continuous, and when a range is read, the most recently determined range correction should be applied to it. The procedure should be as follows:

(a) Registration at a point on the predicted course of the target at the approximate range at which it is desired to open fire, (b) application of the range correction as a percentage correction, (c) *adjustment of the correction* by observation of fire when satisfactory observation is possible. Such changes in the adjustment should be conservative. The registration or trial shot correction should be regarded as more reliable than a

correction based on either sensings or observed deviations equal to or fewer in number than the trial shots.

18. *The necessity for different methods of fire adjustment on moving targets* is due, not to the "variety of calibers employed, varying rates of fire, changing conditions of wind and atmosphere" (C.A.M. No. 4, revised, page 2), but to different conditions of visibility of the target and the water area in its vicinity; also to the character and condition of the fire control equipment and communications.

Different conditions which may reasonably be expected in action should be provided for by our methods for control of fire. While there may be room for controversy as to what are the most probable conditions, an ordinary exercise of imagination suggests that certain ones at least are possible. We are interested in the occasional ones as well as the most probable ones and should overlook none. For example, any of the following conditions may exist:

1st. The weather may be bright and clear so that both target and the impacts in its vicinity are visible from shore observation stations and the number and position of targets such that spotters can identify splashes, also such that one target will not obscure the splashes of shots fired at another. This is the most favorable condition and the one contemplated by methods of adjustment of fire which are described most frequently. Adjustment fire may be directed at the target, by piece or by battery, or at a registration point. If at the target the delay to permit shift of fire to the target is avoided and there is the possibility of a hit on the first shot. Continuous observation of fire throughout fire for effect permits adjustment of the ballistic correction whenever the evidence of observed deviations is sufficient to warrant a change.

2nd. Splashes of shots fired at the target can be observed only occasionally or not at all due to smoke screen or other cause but masts and upper works are sufficiently visible to permit tracking. This is believed to be the most usual condition to be met in action. The method should be careful registration at a point on the probable course of the target at the range at which it is desired to open fire. The correction determined from this firing should be applied as a velocity or percentage correction to be adjusted only in case sufficient observed deviations are determined to justify a change, or by result of additional registration fire. Experience indicates that if the velocity correction be based on sufficient data and atmospheric corrections applied as frequently as changes occur, the effectiveness of fire under these conditions will compare fairly well with that in which continuous observation is possible.

3rd. Conditions the same as those just described except that shots short of the target may be observed from the battery. This is a condition frequently discussed but probably an unlikely one. The pro-

cedure should be the same as in the case just described except that when justified, corrections may be applied as determined by the "Method of Shorts." That is, a correction in the proper direction whenever the proportion of shorts is observed to be greater or less than would be expected from the normal dispersion of the gun if the center of impact were placed so as to give the maximum number of hits for the particular type of target.

4th. Target invisible due to fog. The most promising solution of this problem is in subaqueous sound ranging. With an equipment such as that now installed at Fort H. G. Wright, N. Y., detection of the presence of an enemy would be certain and tracking sufficiently satisfactory to insure reasonable fire efficiency. How effective airplane observation of fire would be under such conditions has not been determined.

Enemy fire would be equally handicapped and navigation extremely difficult under these conditions.

5th. Target beyond the range of vision of shore stations. Such fire may be employed to prevent distant bombardment or to permit the unhampered egress of our own fleet. Accurate fire is not to be expected from either ships or shore batteries. Airplane observation as tried out in the joint Coast Artillery and Air Service exercises in these defenses last fall, subaqueous sound ranging, radio direction finding, and other methods are in the experimental stage. Undoubtedly the advantage of guns ashore over guns afloat can be maintained so long as the former are not outranged. Occasions on which long range firing will be advisable are unusual. None other than emergency methods are available at present for the control of such fire.

6th. Target and vicinity visible so that sensing of line shots is possible but flank spotting impossible due to failure of communications. Under these circumstances tracking with long horizontal base also would be impossible for, if communications with a distant station were intact for tracking, the same station could be used for flank spotting.

Ranges would be determined by a self-contained range finder near the battery. Fire should be registered and corrections if any, made by the method of shorts. If no self-contained range finder be available, the range should be estimated and guns laid at the best guess for a hit, taking advantage of the apparent position of the target with reference to buoys or other marks in the channel if any. If the target be coming in and first shot strike over, corrections should be bold until a hit or a short is obtained. Further corrections should be those judged to give the greatest expectancy of a hit, taking into consideration the rate of change of range. If the target be increasing range the first step should be to get a hit or an over.

19. *Other combinations of conditions* may arise. Generally, condi-

tions may be classified as those admitting of precision methods or those requiring emergency methods.

Precision methods should always include atmospheric corrections based on meteorological observations and a velocity correction based either on a measured velocity or a velocity determined from trial fire at the target or at a registration point. Such further correction from observation of fire as may be advisable should be combined with the initial ballistic correction as an adjustment of the velocity correction or as a percentage correction, or in such other manner that the total correction will vary approximately as the range varies.

Airplane spotting is an emergency method which rarely should be employed at ordinary ranges or when shore observation is possible. Experience in peace time has indicated that with one plane per battery reports of the deviations of not more than 43% of the shots fired will be received at the battery. Two planes per battery will increase this figure to 76% and three planes per battery will increase it to 82%. This is on the assumption that the aviator will not be interfered with by enemy planes or antiaircraft fire and that the firing battery holds its fire for a signal from the observing plane. An enemy will have little difficulty in interfering seriously with our radio communications, and, if he be willing to sacrifice his own, almost certainly can jam ours effectively.

Recommendations:

1. A Coast Artillery memorandum or bulletin should be issued annually from the office of the Chief of Coast Artillery, outlining the latest approved methods for training and target practice in preparation for action of fixed and mobile guns against naval targets. Each memorandum or bulletin should be complete in itself and should displace all former memoranda or bulletins covering the same subject.

Information concerning methods for artillery firing at land targets should be issued separately.

2. It is further recommended that the publication of this report in the COAST ARTILLERY JOURNAL be authorized for the purpose of stimulating interest in this subject and to invite discussion and correspondence with the Board.

(Sgd.) H. J. HATCH,
President.

An Introduction to the Construction of Nomographic or Alignment Charts

By First Lieutenant J. J. Johnson, C. A. C.



THE object of this article is to present a detailed explanation of the theory and construction of a few simple forms of nomograms.

Due to their comparatively recent origin and notwithstanding their present extensive use in gunnery as well as in engineering, the theory of the nomogram is not common knowledge even among engineers. There is another reason for this neglect, namely that artillerymen and engineers, like other people, have developed fixed habits in their methods of solving problems. Some have a predilection for the use of tabular values; others get into the habit of solving problems by means of a slide rule; and some others use charts.

With the improvement in the slide rule, particularly with the introduction of the log. log. slide rule which permits of the solution of problems involving exponentials, it may be argued that the slide rule is to be preferred. As far as essentials go an endeavor will be made to show that the nomogram is a generalized form of slide rule, and consequently not only adapted to the solution of problems limited to the use of the slide rule but to others as well. A slide rule is essentially a device for adding logarithms graphically, whereas a nomogram may have uniform or logarithmic scales, or both, and their direction need not be parallel.

There will be no need to go into technicalities nor to make elaborate scientific statements, for the simple reason that no technicalities are involved in these graphical representations of equations of two or more variables. Obviously there may be hundreds of different nomograms and they can be as complicated as the expressions they represent. More time may be spent in making the computations for the construction of a chart which can have little practical use, whereas charts which are simple as well as useful can be easily made. Since the object in presenting this article is to explain to those unfamiliar with nomography, a few simple forms, much that will be set down will appear obvious and commonplace.

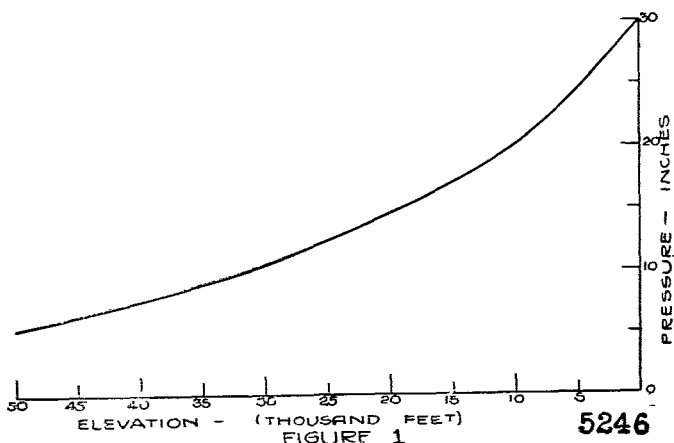
The ordinary process of graphical computation consists in plotting a curve which represents the relation between two variables. This kind of graph is based on the principle that points along the base line represent values of one quantity, while the varying height of the curve above the base line shows how a second quantity varies with the first.

Figure 1 shows how the pressure decreases as the elevation increases. It shows how one quantity, y , the height of the curve (i.e. the pressure) varies with another x , the elevation. Whenever such a quantity, y , varies with another, x , in some definite way, y is called a function of x . The quantity, x , upon which y depends is called the independent variable. The relationship in Figure 1 may be expressed mathematically by saying that the pressure, a dependent variable, is a function of the elevation, an independent variable, and we write the relation, thus, using y to represent pressure and x elevation:

$$y = f(x),$$

read, y equals a function of x .

The formula for the ballistic coefficient is a familiar example of a function. $c = \frac{w}{id^2}$. For a given projectile (w , the weight, and d , the diameter, being given), the formula expresses the fact that the ballistic coefficient is a function of the coefficient of form (i).

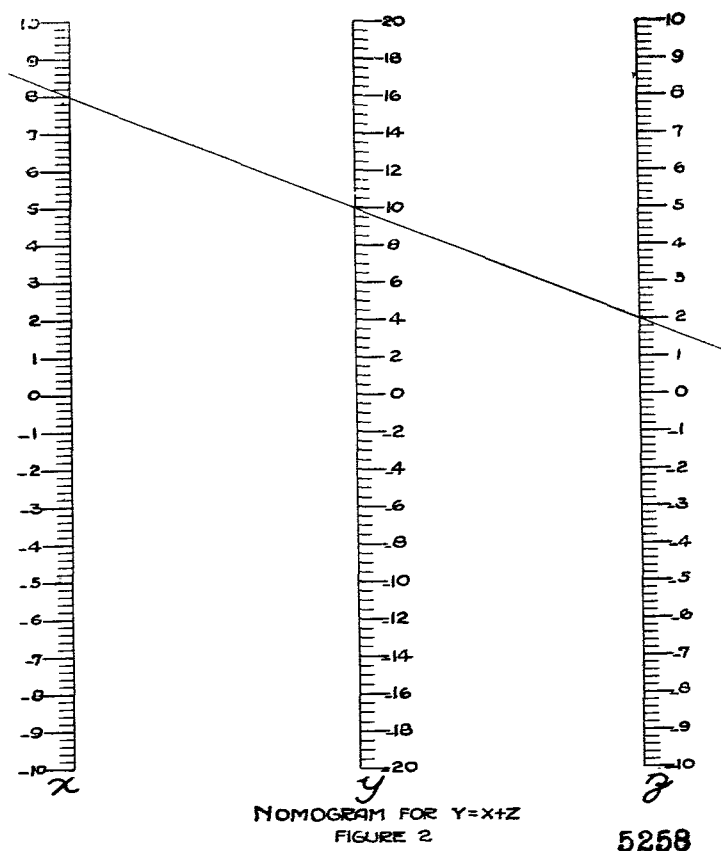


Having refreshed our minds on the idea of a function, we can appreciate the following:

One of the principles upon which the nomogram is based is "the idea of the representation of a function of a variable by a scale." These scales representing the functions in a given equation are plotted in such a way that a line cutting the scales will give a set of values of the different variables which will satisfy the equation composing these variables.

Consider the equation $x^2 + ax + b = 0$. a and b can assume a certain number of values so that it will be necessary to plot separate curves for the particular values of a and b that occur in each such equation. There are certain modifications of the method of solving this equation by means of rectangular coordinates, but the best we can hope

for is a family of curves. By means of a nomogram we can solve this form of equation expeditiously and accurately, for "nomography applies to that method of graphic calculation, in which all the solutions of a formula which are likely to be required are embodied in a permanent diagram with figured scales, drawn once for all and read simply by the intersection of lines or the alignment of points on it."



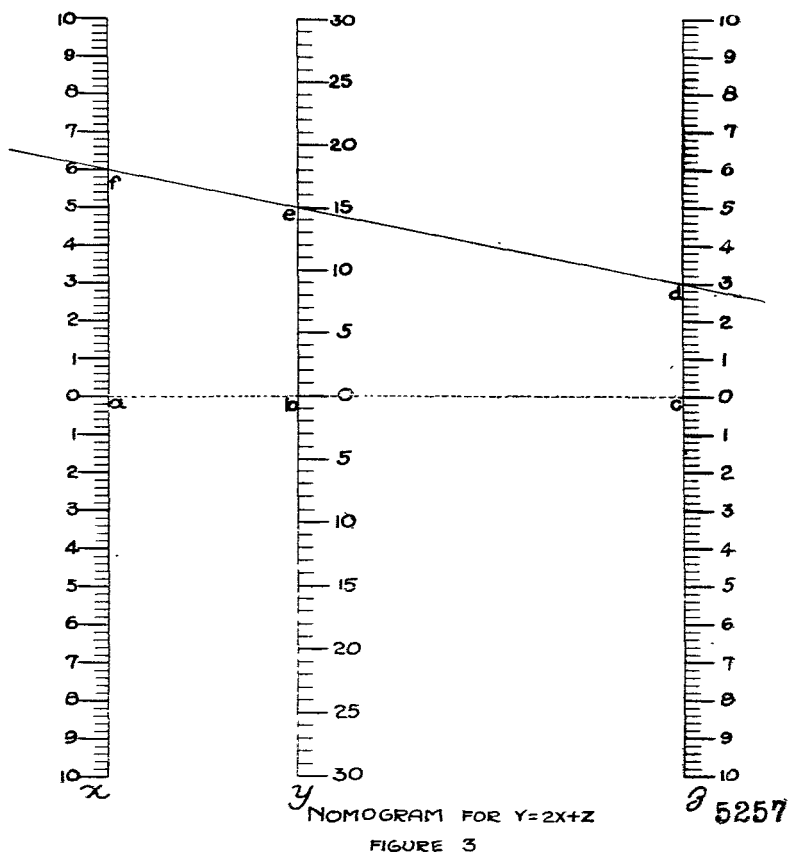
In Figure 2 we have three uniform scales with their zeros collinear (i.e. being in the same straight line). The outer scales, x and z , are graduated with the same unit, but the inner scale, which is midway between them, is graduated with half their unit.

Connect the graduations 8 on the x scale and 2 on the z scale with a straight line. If the y scale had been graduated with the same unit as are the x and z scales, the straight line thru the points 8 and 2 on the outer scales would cut the y scale at the point 5. But the y scale is graduated with half the unit used in the x and z scales, therefore the y graduation is equal to the sum of the x and z graduations. That is, $y = x + z$.

In Figure 3 the y scale is graduated with a unit one-third of that used in the x and z scales, and it is twice as far from the z scale as it is from the x scale.

$$be = \frac{af + \frac{be + cd}{2}}{2} = \frac{2af + be + cd}{4}$$

$$3be = 2af + cd$$



or three times distance $y = \text{twice distance } x + \text{distance } z$. As the unit used in the y scale is one-third of that used in both x and z scales, then:

$$\text{Graduation } y = \text{twice graduation } x + \text{graduation } z, \text{ or}$$

$$y = 2x + z.$$

The generalized nomogram

$$y = lx + mz$$

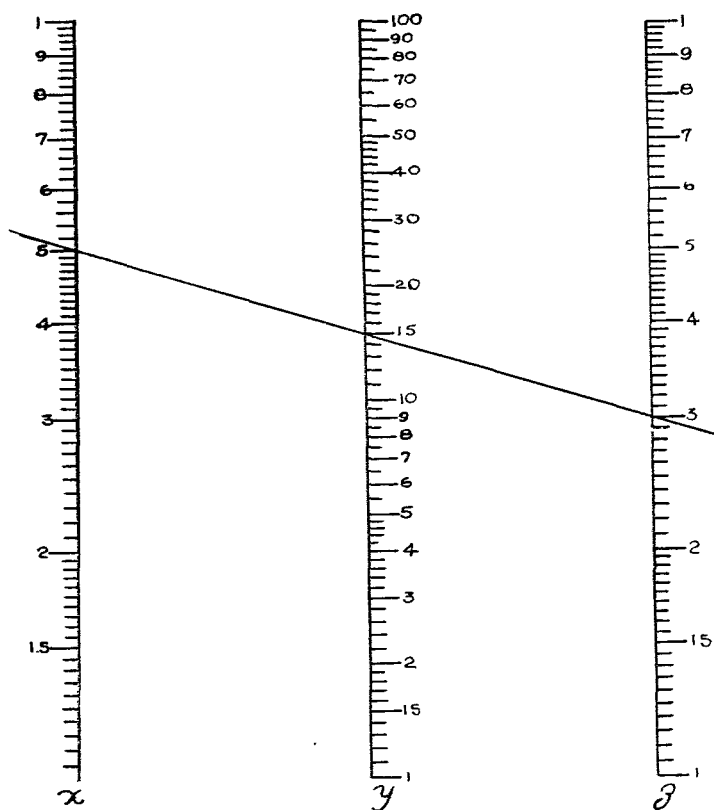
may now be developed.

If in Figure 3 we take the x and z scales as shown, but consider the y scale displaced so that its distance from the x scale is to its distance

from the z scale, so as m is to 1, we can show that a straight edge will cut off distances on the three scales such that

$(1 + m)$ times distance $y = 1$ times distance $x + m$ times distance z , provided of course the origins of graduation are collinear.

If we graduate the y scale so that its unit is $\frac{1}{1 + m}$ of the unit used in the x and z scales, then:



NOMOGRAM FOR $Y=XZ$
FIGURE 4

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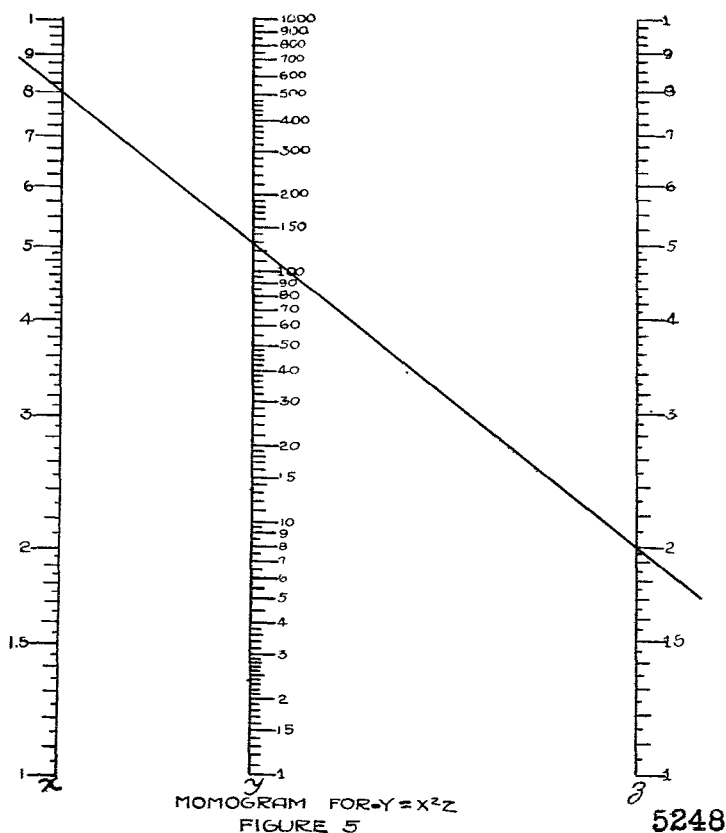
$\left(\frac{1}{1 + m}\right) (1 + m)$ times distance $y =$ graduation $y = 1$ times graduation $x + m$ times graduation z , or $y = 1x + mz$.

The next step is to convert the nomogram for addition into a nomogram for multiplication. This can be done readily by replacing the uniform scales with logarithmic scales. In other words if in place of the numbers we lay off their logarithms, we may read products instead of sums.

The logarithmic scales may be constructed by laying off the logarithms

as given in the tables, the distance of any graduation from the beginning of the scale being proportional to the logarithm of the number of the graduation.

In the absence of logarithmic paper, take a convenient length, say 10 inches, to represent log 10 or unity. Measure off a length of 3.01 inches from the beginning of the scale to represent log 2, a length of



4.77 inches from the beginning of the scale to represent log 3, etc. The scale may then be sub-divided, depending on the size of the diagram and the accuracy required.

Since the powers of ten do not affect the mantissa,

$$\begin{aligned}\log 3 &= .4771 \\ \log 30 &= .4771 + 1 \\ \log 300 &= .4771 + 2 \\ \log .3 &= .4771 - 1 \\ \log .03 &= .4771 - 2\end{aligned}$$

but differ only by an integer, we may consider the scales to run

from 1 to 10
 from 10 to 100
 from .1 to 1, or
 from .01 to 1.

The complete logarithmic scale consisting of a number of repetitions of the scale from 1 to 10, and the segment of the scale from 1 to 10 to refer to the numbers 10^n to 10^{n+1} , where n is a whole number, either positive or negative.

In Figure 4 the y scale is graduated with half the unit used in the x and z scales and it is midway between them. A straight edge will cut out distances such that \log graduation $y = \log$ graduation $x + \log$ graduation z

$$\log y = \log x + \log z \text{ or, } y = xz.$$

Suppose we wish to construct a nomogram for

$$y = x^2z.$$

which may be written, $\log y = 2 \log x + \log z$

This may be accomplished as in the case of the nomogram for addition, by bringing the y scale twice as close to the x scale as it is to the z scale. A straight line across the scale will cut off distances such that 3 times distance $y =$ twice distance $x +$ the distance z . And by graduating the y scale with one-third the unit used in the x and z scales, we get

$$\log \text{ graduation } y = \text{twice } \log \text{ graduation } x + \log \text{ graduation } z$$

$$\text{or } y = x^2z$$

There is another simple method of constructing a nomogram for $y = x^2z$. Instead of changing the position of the intermediate scale, the desired result may be had by changing the unit of graduation of the outer scales. In other words, instead of changing the horizontal interval between scales we can obtain the same result by changing the magnitude of the outer scales.

In Figure 6 the unit used in graduating the x scale is twice that used in the z scale, and that used in the y scale (as in the case of the nomogram for addition) is one-half that used in the z scale. Bearing in mind that the distance of any graduation from the origin of the scale is proportional to the logarithm of the number of the graduation, a straight line will cut distances off the scales such that \log graduation $y =$ twice \log graduation $x + \log$ graduation z

$$\log y = 2 \log x + \log z \text{ or, } y = x^2z.$$

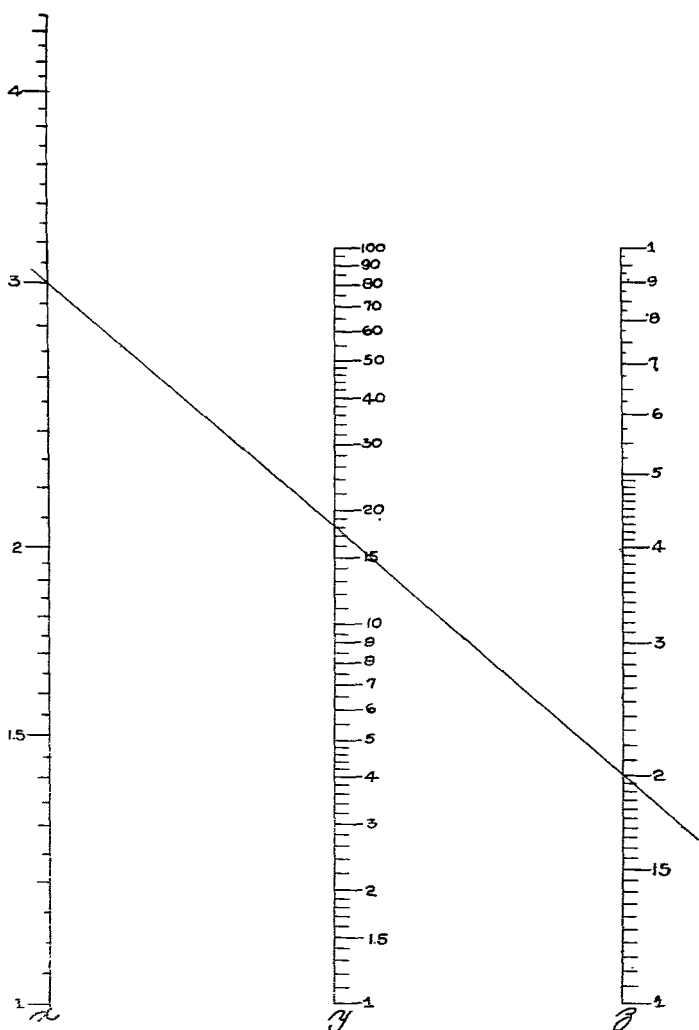
Let us consider the generalized nomogram, $y = x^l z^m$.

Since in Figure 3 we have graduation $y = l$ times graduation $x + m$ times graduation z for the generalized nomogram $y = lx + mz$, and if we change from the uniform scales in Figure 3 to logarithmic scales, we can readily see that \log graduation $y = l$ times \log graduation $x + m$ times \log graduation z ,

$$\log y = l \log x + m \log z, \text{ or}$$

$$y = x^l z^m$$

In other words the ratio of the distances m and l is inversely as the ratio of the exponents of x and z . Whether we shift the position of



NOMOGRAM FOR $Y=X^2Z$
FIGURE 6

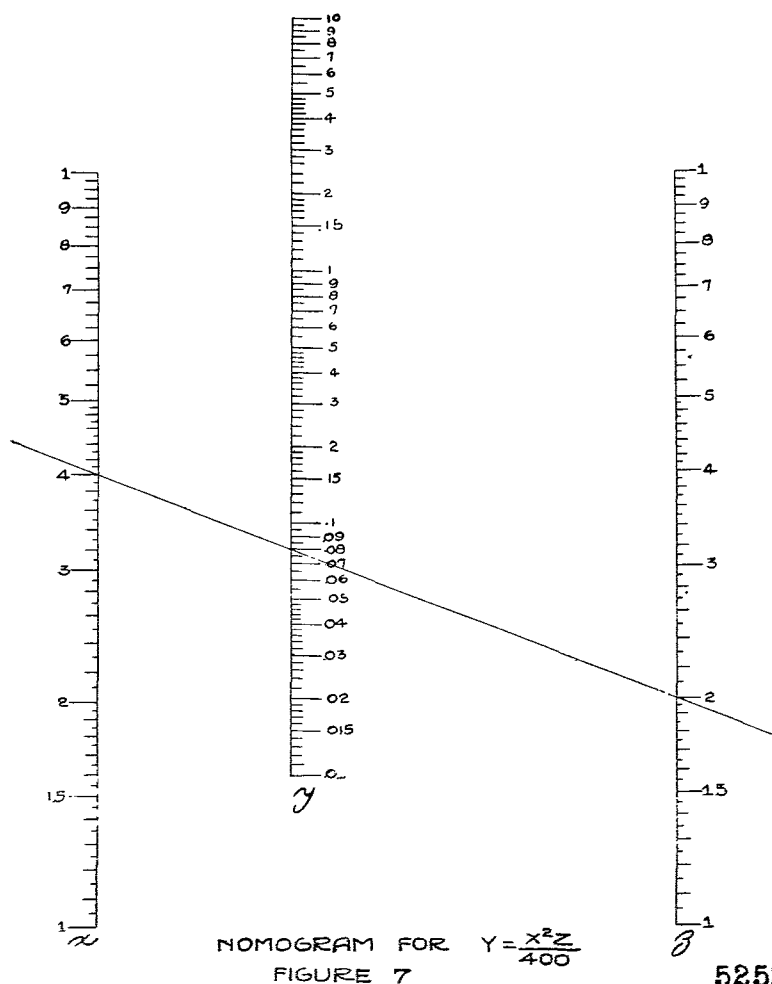
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the intermediate scale according to the spacing ratio m/l or change the magnitude of the units used in plotting the outer log scales, depends upon the range of values the three scales will have for a particular solution. A study of the problem may require a combination of both methods.

The next step is to take care of any constants in the formula.

The nomogram for $y = \frac{x^2 z}{400} = 0.0025 x^2 z$, may be constructed as follows:

We may use the same spacing interval between the x and y and the y and z scales, in which case the magnitude of the unit of graduation in the y scale will be one-third that used in the x and z scales, or we may



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take the spacing interval between the x and y, and y and z scales inversely as the exponents of x and z, in which case the y scale will be twice as far from the z scale as it will be from the x scale. We will choose the latter method.

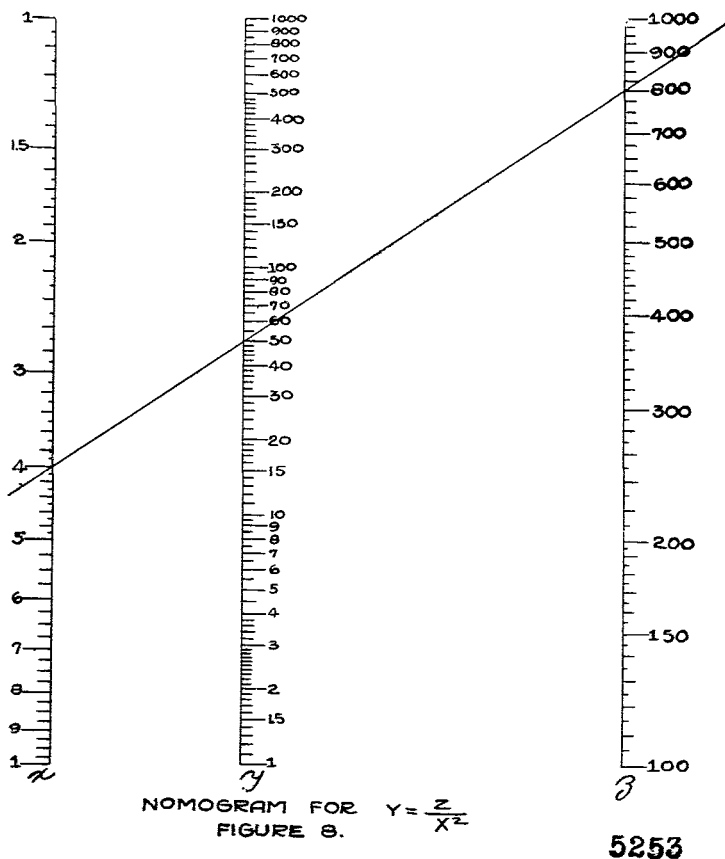
The above equation may be written

$$\log y = \log 0.0025 + 2 \log x + \log z \text{ or}$$

$$\log y - \log 0.0025 = 2 \log x + \log z$$

We next determine where the beginning of the y scale shall be, since the introduction of the constant in the formula will result in a vertical displacement of this scale.

The starting point of the y scale may be known by noting that when x equals unity and z equals unity, y will equal $\log 0.0025$ or $0.602-3$. The length of the logarithmic interval from 1 to 10 used in the x and z



scales is 10 inches, and since the unit used in the y scale is one-third that used in the x and z scale, the y scale will be moved vertically upward an amount equal to $1 \frac{2}{3}$ of 6.02 inches or 2 inches.

In making the original drawing for Figure 7, lengths of the x and z scales were taken to be 10 inches, which is the same thing as saying that the 1 to 10 logarithmic interval was taken as 10 inches. This has been found to be a convenient length in constructing nomograms.

Let it be required to construct a nomogram for

$$y = \frac{x}{z}$$

This may be done simply by interchanging the x and y scales in Figure 4. By relettering these two scales we have $x = yz$ or $y = \frac{x}{z}$, a nomogram for division. Another way is to lay off the log scale on z , Figure 4, from top to bottom. This will take care of the negative exponent in

$$y = xz^{-1} = \frac{x}{z}$$

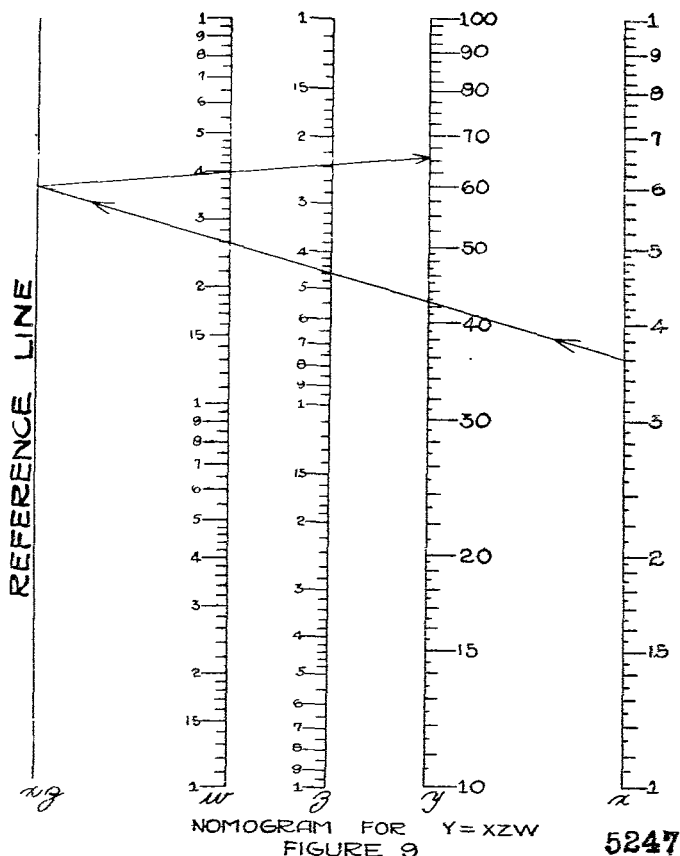
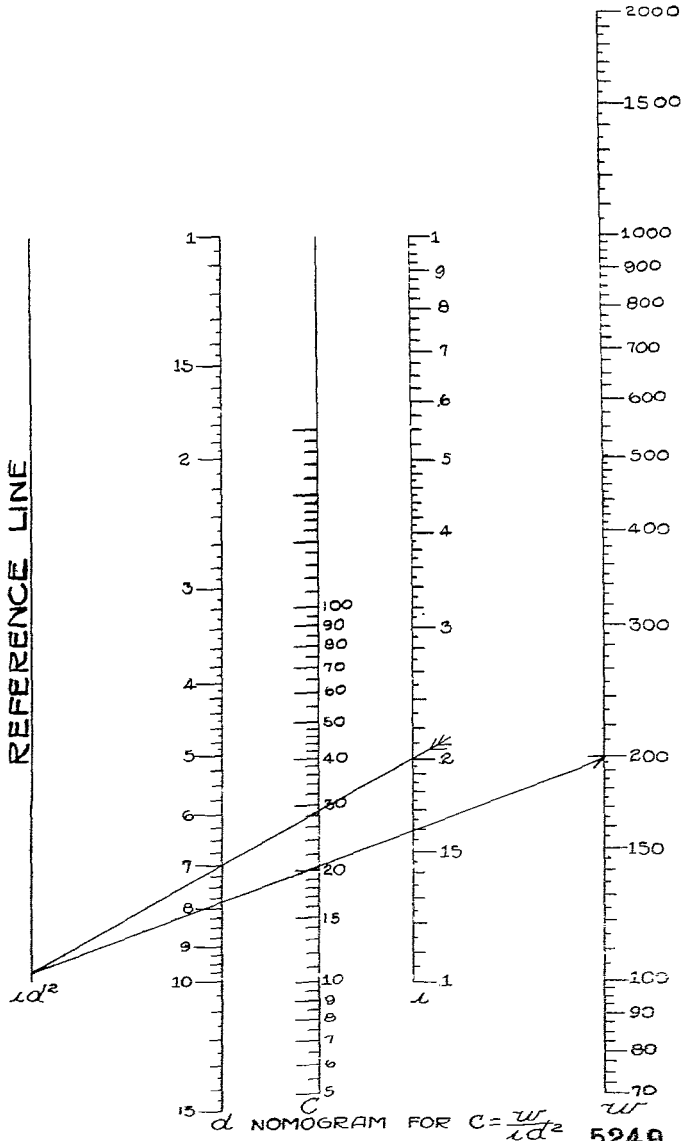


Figure 8 is a nomogram for $y = \frac{z}{x^2}$

Since $y = \frac{z}{x^2} = zx^{-2}$, the x scale was graduated in the reversed order, the spacing interval between y and z being twice that between x and y , and the unit of the y scale, one-third that used in the x and z scales. From the formula $y = zx^{-2}$ we get

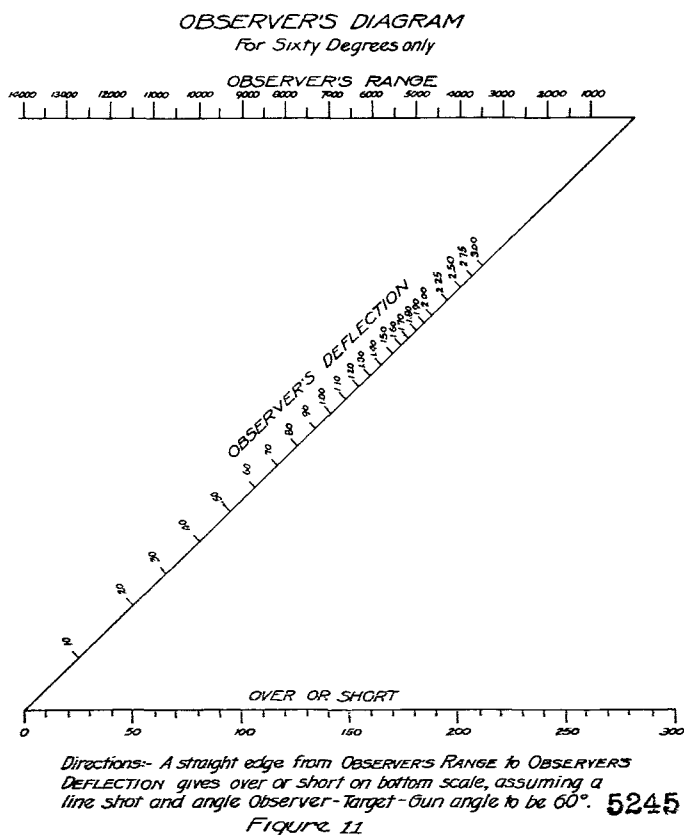
log graduation $y = \log \text{graduation } z + \text{minus twice log graduation } x$. But we graduated the x scale in the reversed order (i.e. from top to bottom instead of from bottom to top), making the spacing interval



between y and z twice that between x and y , and we graduated the y scale with one-third of the unit used in the x and z scales. The nomogram therefore, in Figure 8, satisfies the formula $y = \frac{z}{x^2}$.

The method of constructing a nomogram for *more* than three variables is simply an extension of the method used for three variables.

To construct a nomogram for $y = xzw$, first construct a nomogram for the partial product xz , and with this product as the start and the third factor w construct a similar nomogram. The scale for the partial product xz need not be graduated since the partial product is not desired, the scale being used simply as a turning line. These turning lines are known as reference lines or support lines.

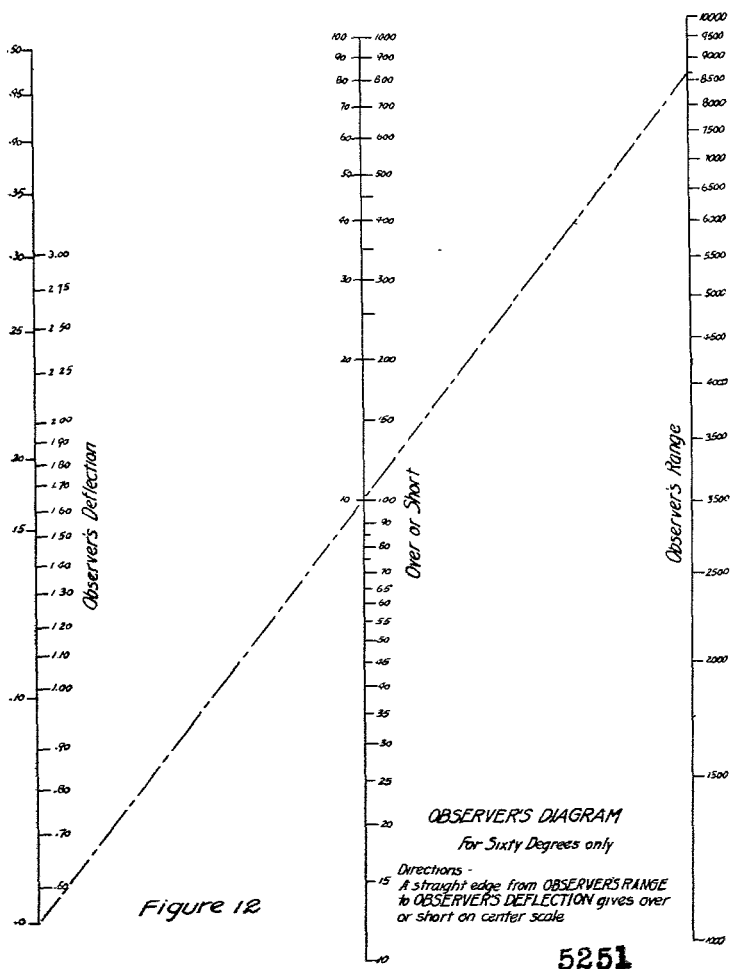


At least for the form of nomogram we have been considering it is evident that the mathematical principles involved are simple and their application is easy. For the less simple forms the application of these principles is not difficult provided the right clue has been discovered. This does not mean there is any thing deeply hidden, but simply the idea of getting on to the knack of the thing. Facility comes from practice.

In Figure 9 the nomogram for the partial product $y^1 = xz$ is con-

structed with the z scale midway between x and y^1 (i.e. xz) scales, the unit of the z scale accordingly being one-half that of the x and y^1 scales.

The graduations of the y^1 and z scales are in the reversed order. We then have for this nomogram, for $y^1 = xz$,



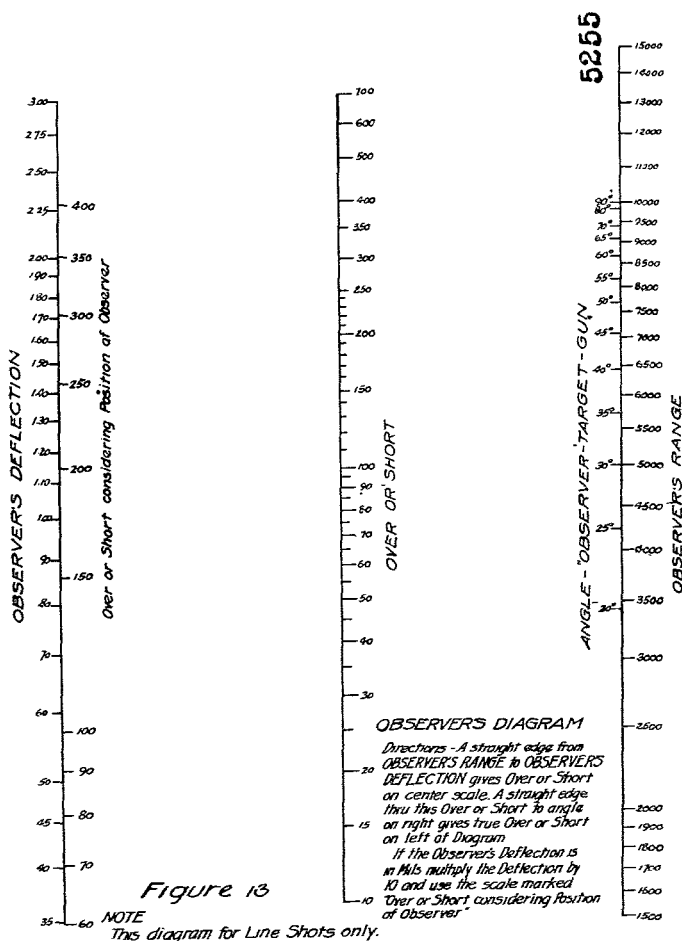
minus log graduation z
 $=$ minus log graduation $xz +$ log graduation x , or,
 log graduation xz , or, y
 $=$ log graduation $x +$ log graduation z ,
 $y^1 = xz$.

To obtain the final product using xz and w as factors, consider the scale w midway between xz and y , with a unit one-half that used in xz and y . We have for this second nomogram

log graduation $w =$
 minus log graduation $xz +$ log graduation y , or
 log graduation $w +$ log graduation $xz =$ log graduation y

This is one of various methods that may be used in charting a nomogram for four variables.

The nomograms, Figures 4 to 9, were constructed without reference to range of values of the variables, for the reason that these charts



were used simply to illustrate methods. In the remaining figures the ranges are given. For instance in Figure 10, the weight of projectile, w , is shown to include values from 70 to 2000 lbs., the diameter, d , in inches, from 1 to 15, and the coefficient of form from 0.1 to unity. To use Figure 10, lay a rule through the values of i and d . From the point where the rule meets the Reference Line, lay the rule to the proper

value of w . The intersection of the rule with the C scale gives the value of C.

The nomograms shown in Figures 11, 12, 13 and 14 were designed by Major P. H. Ottosen, C. A. C., and used with great success at target practice, at Battery Moore, Fort Casey, Washington, in 1916.

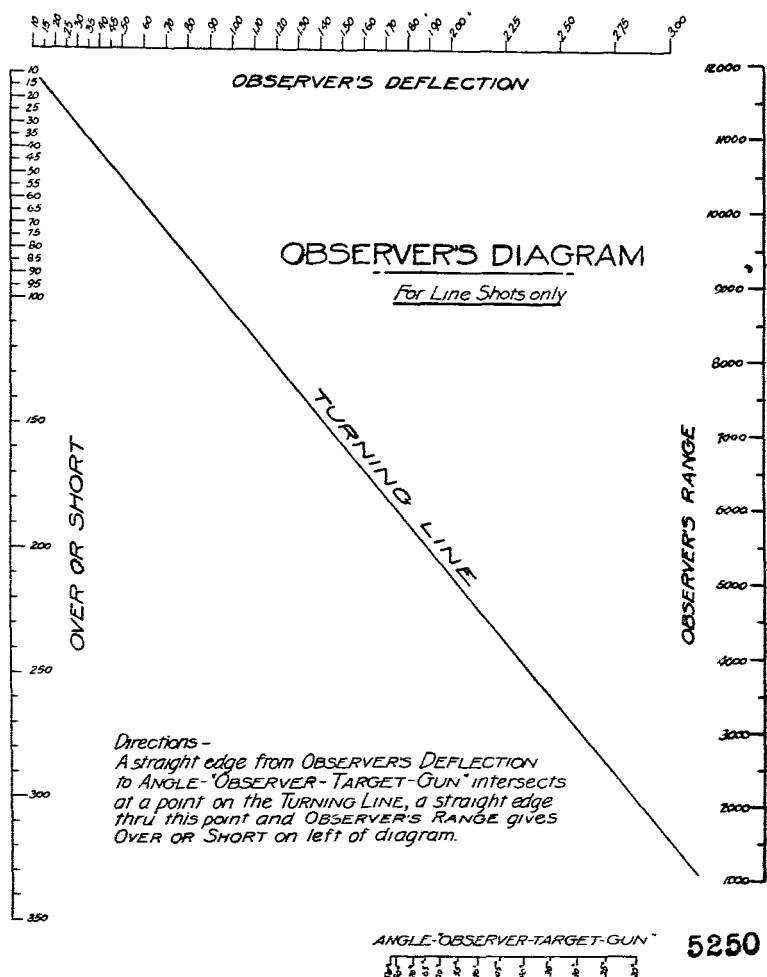


FIGURE 14

The standard work on the subject is d'Ocagne's *Traité de Nomographie*, Revised 1921. Among the works in English may be mentioned *Graphical and Mechanical Computations* by J. Lipka, 1921, John Wiley Sons, and *A First Course in Nomography*, by S. Brodetsky, 1920, Open Court Publishing Co. Articles in English have also appeared from time to time in Engineering, Mathematical, and Service Journals.

Captins and Lootinants

By Captain Joseph C. Haw, C. A. C.

"Charlie Molbridge! I ain't seen him since Moses was a mess-sergeant. Is he still in the Islands?"

"He is *not*. He was dismissed th' Service right afther New Years, poor devil."

"Ye say Charlie Molbridge was dismissed th' Service?" Old "Snap" Larrigan exclaimed.

"Yep. He went all to pieces, what with likker an' the tropics," replied the other, a slightly younger man with a first sergeant's chevron upon his sleeve. "Just went to hell."

"'Tis a pity—no, 'tis a dirty, stinkin' shame. Oi was top cutter in th' ould five-wan-three coompany whin he jined, an' a foine bright lad he was. Four years in Piddlin' Pete's outfit done for him, Bucky."

"Whaddaya know about that? I never thought Piddlin' Pete had spunk enough to lead a man to drink."

"Ye're right—he did not. But he niver give th' lad no responsibility—no reg'lar stiddy job he could take a pride in doin' well—an' it desthroyed th' boy's inthrist in his work. Him bein' bright an' high-spirited, natch'ally he tuk to dhrink. Yis, 'twas the makin's of a foine officer was spoiled be piddlin'."

"Ain't I had that kind meself? I got busted a-purpose after six months of "Pottering Paul" Monson, and when Lootinant Jameson got his orders for the Canal Zone, I heard him say to Lootinant Cook 'Thank God, Cook,' he sez, 'I'll get out of this devilish company. I don't mind any kind of work,' he sez, 'but I hope my next captin will give me some responsibility, some definite job. I've bin in the Service five years now, and the only stiddy work this captin ever give me was to balance the company fund book at the end of the month—an' he only done that because he messes it up every time he does it himself,' he sez. Oh, but he was bitter!"

"Now ye have opened up a subjick upon which I have thought much," said old Larrigan. "Th' ways of a maid wid a man are strange, but not near so quare as th' ways of a captin wid his lootinants. Sure, I ought to know, too. Over thirty years was I in th' Service, half of ut a top cutter, an' in France a lootinant an' captin."

"Yis, captins an' lootinants I can read like books—'tis not so hard either, Bucky, me bhoy. An' I've marvelled at 'em; for years have I marvelled."

"Ye see, Bucky," and now the stubby pipe stem was pointed at the second button of "Buck" Lennon's blouse as the old soldier warmed to his topic, "ye will admit thot th' captin has a grand opporchunity to mould his lootinants—to 'assert his leadership,' the regulations calls it. There ain't no associashun so close as that bechune th' captin an' his lootinants. Furthermore, mcst gin'ally they comes from th' same class av peepul, have th' same kind of eddication, an' th' same future befoore thim. An' th' captin has bin a Lootinant himself, too. Thin besides, the lootinant is younger, and shorter in th' service, an' he is aizy impressed an' aizy led. Whin he jines up, he is ready to accept the captin as a hayro. For all these raisons, 'tis aizy for th' coomp'ny commandher to assert his leadership.

"But does th' captin see this? Does he do anythin' about ut? No! many toimes he is aslake at th' switch. What is th' raisult? Why, bein' a bright, well-eddicated young lad, it does not take th' lootinant long to size up his suparior. His brain, though not so machoor, is equal to th' captin's—sometoimes betther. Th' captin cannot bluff him. Th' min know th' captin well; th' top kick knows him betther nor his own wife do; but th' brave young lad knows him betther thin he knows himself. Ain't it thrue, Bucky?"

"You bet. Even in technical matters which ain't yet well understood by the boy, the captain can't bluff him, because a keen young feller don't have to be acquainted with no arithmetic to find out whether a man really knows what he is talkin' about."

"An' answer me this, Bucky: how many captins have yez served wit' that was hayroes to th' lootinants, eh?"

"Mighty few; mighty few, sarge. And them as was, they was real, all-around he-men, *believe me*."

"*Oui, oui*. There's many a good man sspoiled in his early years av service. For mind ye, if a man is av suparior ability, he will overcome th' handicap av a poor thrainin'; he will thrain himself; yit he misses much. But th' others! Th' average man who gets off to a bad start may niver overcome it. Av coorse, 'tis but few will go to th' dogs, aven tho' wimmin an' gamblin' be not yet extink. Th' most av thim will suffer chiefly in their effeeciency. They will be piddlers, p'haps; or wantin' in th' all-roun' mil'tary knowledge an officer shud have; or aven—an' this is th' worst—lackin' in th' fundimintal qualities of a sojer."

"Well now, sarge, just what do you call a 'bad start'?"

"Why, be thot I mane th' condition thot raysults whin th' captin fails to do his jutty be his lootinants. There are foive principal juties, Bucky, thot he owes to thim."

"First, ye will grant that after all th' lootinant will not be a lootinant all av his service. Therefore he must prepare himsilf for th' future. Now there is much in war thot can be learned in toime av peace only

be study. So th' coomp'ny commandher must encourage th' boy to consither th' problims av war as prisinted in books be thim thot ondersthands th' business av sojerin'."

"But who expec's a youngster to study?"

"Ay, 'tis throe that they prefer other amusemints, in th' natur' av things. But they has some toime whin there is naught else to do, so why shud they not use it to improve their intellecks? . Moreover, a mon must have a hobby. Why shud not th' study av his professhun be his hobby? Ye know how they do run to gadgets an' slipsticks for th' plottin' room in their early days. Howiver, too often they do not study th' ways av throops thot do move about frum place to place, an' for why? Because nobody iver dhraws their attintion to th' 'fac' thot war is movemint. Faith, an' how are they to know thot widout somebody tellin' thim? So I sez, 'tis up to th' captin to insphire thim wid an inthrist in th' broader things av th' professhun av arms.

"Thin, av coorse, it goes widout sayin thot they shud be rotated from job to job in th' outfit until they have hild thim all. Have I not knowed lootinants who was niver range officers? An' others thot had niver superintinded th' clainin' av recoil cylinders? An' some thot cud not make out a final statemint? An' agin others thot had niver run th' coompany mess? How kin th'loikes av thim command a coompany?"

"Thin there is th' study av leadhershhip. Th' throe leadher is born, but they are few; forchunately however, th' av'rage officer kin be diviloped into a fair leadher. 'Tis not a subjick thot has set rules; but if a mon's attintion be attracted to th' matter, he can learn much be observashun an' thought. In toime av p'ace, in th' reg'lar army, any raisonable mon kin git along some sort av way, becuz he has th' power av' th' gov'mint at his back, he is but rarely thrown upon his own resources intoirely, an' he has experienced non-coms to hilp him. In toime of war 'tis diffrint intoirely. Th' officer is advanced to a grade whose juties he has prob'bly niver performed; he has siv'ral toimes as many min undher him as iver befoor—an' all av thim green as grass, both officers an' min. It takes rale leadhershhip to turn thot mob into a dischiplined organization, an' lead ut in battle.

"Yes, 'tis nicissary to study th' ways av min, to learn how to size thim up an' how to insphire their actions. An' th' captin can do much be kapin' this always befoor th' lootinant's mind, an' discussin' wit' him th' cases thot arise, showin' th' lad th' rasons for his decisions.

"Now, Bucky, I have coom to a thing av th' first importance. Can ye guess it?"

"Well, sarge, you have mentioned nothin' of making a soldier of the young man."

"Ye have hit it square! Th' most important thing for him to learn, av coorse, is th' fundamintals av bein' a good sojer. No matther what th' lootinant has larned pravius to receivin' his commission, a lack

av judgmint be th' coompany commandher may foriver ruin him from bein' a thrue sojer. I have seen ut. What lad could iver be loyal afther listinen' daily to his coompany commandher knockin' ivery ordher thot coom down, an' ivery suparior he iver heard uv? Who could larn th' thrue manin' av th' word *juty* if th' captin was late to half th' formations, or wint on sick report because he had bin on a bit of a party th' night before? Who could take a pride in his outfit if its commandher was always talkin' about what a poor bunch av min he had undher him? Who will strive to be neat an' snappy if th' Ould Man is sloppy an' slouchy?

"I tell ye now mon, thot in ivirythin' 'tis th' example of th' captin thot counts tin toimes as much as his words, but in th' line av sojerin it counts a thousand toimes as much. An' th' worst kind av captin is th' mon that's always knockin'.

"There's no doubt about ut at all that th' captin's first juty is to tache rale sojerin. A damn fool can't be a good sojer, but barrin' damn fools, in toime av war I would rather serve undher a stupid man thot had absorbed th' principles av dischipline thin under a bright mon thot was undisciplined. So sojerin is th' fourth thing; but there is yet one more, th' fifth juty av th' coompany commandher.

"This is not somethin' thot th' lootinant must be taught, but 'tis somethin' thot is nicissary for his welfare. Ut is thot th' lootinant must be give satisfaction in his work. Anybody kin see thot unless he gits some satisfaction out av his work, he will take no inthrist in ut, an' be th' same token ut will therefore be impossible to tache him any av th' four things he must learn.

"Now ut is only proper thot th' lootinant shud do th' dirty work aroun' th' coompany, th' piddlin' odds an' ends. But if this is all, he soon hates th' thought av his job, an' shirks if he can.

"Th' solution, Bucky, lies in wan word—responsibility. He must be give responsibility. Thin he is not only liable to catch th' divil if he does wrong, but on th' other hand he is entitled to credit if he does well, an' he can therefore take a pride in his work an' feel th' satisfaction av successful accomplishmint. An' in no other way but be givin' him responsibility can he be afforded a chanct for satisfaction in his daily life."

"Ut is in th' coorse av educatin' thim in th' various details av work around th' batthrey an' th' coompany thot responsibility may be laid upon thim. There is a point here about which th' captin must be careful. Practically ivery reg'lar job is held be a non-com, excipt only these av range and implacemint officer an' platoon commandher. These min had rather do their own work than have th' lootinant interferin' wid thim. If th' lootinant be lazy, or th' captin had not showed thot he wishes th' lad to take full responsibility, th' non-com will still do all th' rale work an' th' lootinant will actually exercise but little responsi-

bility. Therefore th' coompany commandher must personally see to ut that while th' lootinant is first learnin', he shud as near as possible perform all th' functions av th' office, such as mess sergeant or gun commandher. Afther th' lad knows th' game, thin he should exercise a more gin'ral supervision."

"Yes—afther the lad knows the game. It seems to me, Sarge, that all this applies only to shavetails. How about them as have served some years?"

"Me argumints are equally throe, Bucky. Th' captin still has th' same five juties to perform; for remimber this, me lad, no man can iver learn all there is to know about any wan of the four things a lootinant should be taught, let alone the four of thim together. If th' lootinant has had some service, thin 'tis for th' captin to discover in what respects his trainin' has been deficient, and to correct those th' first av all; an' thin to continue his eddication on all lines. Th' captin is forced be his position to assert his leadhership; besides, he is still th' senior in length av service, an' usually in years. Therefore he shud have no difficulty in th' matther.

"As for th' fifth juty av th' coompany commandher, no matter how ould th' lootinant may be, 'tis still th' captin's place to give him responsibility an' satisfaction in his work. In fac', 'tis probable thot th' older and more experienced a mon is, th' harder it is to foind responsibility thot will satisfy him, for he is liable to want a bigger job than th'coompany affords to a lootinant."

For a time there was silence, while the old man refilled and lighted his pipe. He took a couple of long reflective draws that sent the smoke lazily drifting toward the window.

"It all gets back to th' same thing, Bucky. Captins is so oftin thoughtless. They do not r'alize their opporchunities and their juties. Many a captin would die of mortification if he knowed what his lootinants did think av him.

"Five juties there are: to insphire a lad to study th' art av war; to give him plenty of well-rounded experience undher proper guidance; to kape his mind focussed upon th' subjick av leadership, and tache him about ut; an' first, last, an' all th' toime, to make a sojer av him. Thin finally, ut is absolutely necessary thot th' lootinant be give a chanct for satisfaction in his work."

Another pause, and the speaker's voice grew a bit husky.

"I hope great things from me own boy, Bucky. He graduates from th' Point in June. He is boun' to make good, but" —a couple of violent puffs—"be all th' Saints, I hope he gits th' right captin!"

EDITORIAL

Harding—Commander in Chief



AS a true soldier has always been willing to do, our Commander in Chief has died in the service of his country. With the utter disregard of self-care which spells the ultimate ideal of patriotic service, President Harding spent his life ungrudgingly in the task of leadership.

With America, the Army mourns. Though sympathy can be but empty consolation, Mrs. Harding is being supported in these sad days by the spiritual radiation of the sympathy which wells unrestrained from the hearts of soldiers in every far flung garrison where droops at half-staff the starry flag. None more than soldiers can sense the comradeship which was hers, and which for a time, is snatched from her.

In this sad hour, we are brought anew to grasp the spirit of the leadership which is marked by the course of our departed Chief. As soldiers, we cannot forget that he said "Our eyes never will be blind to a developing menace, our ears never deaf to the call of civilization." Nor can we fail to be reconsecrated to the severe ideal phrased in his simple statement, "Service is the supreme commitment of life."

With this simple principle to guide us in the varying fields of leadership which are entrusted to us, each may share the thought of the leader, too soon gone, when he said, "I accept my part with single-mindedness of purpose and humility of spirit, and implore the favor and guidance of God in His Heaven. With these I am unafraid and confidently face the future."

To him who can live in the spirit of this pronouncement will be afforded the consolation of sacrifice which must have colored the twilight hours of President Harding if he but remembered his own words of an earlier occasion, "It is one of the supreme compensations of life to contemplate a worth-while accomplishment."

COAST ARTILLERY BOARD NOTES

"Communications relating to the development or improvement in methods or materiel for the Coast Artillery will be welcome from any member of the Corps or of the service at large. These communications, with models or drawings of devices proposed may be sent direct to the Coast Artillery Board, Fort Monroe, Virginia, and will receive careful consideration."—

JOURNAL OF U. S. ARTILLERY JUNE, 1922.

Work of the Board for the Month of June, 1923

A. NEW PROJECTS INITIATED DURING THE MONTH OF JUNE, 1923

1. **Project No. 135, Radio Communication Equipment for Mobile Coast Artillery.**—The radio communication equipment for all arms is being revised by the Signal Corps in conjunction with the branches of the service concerned. The Coast Artillery Board is considering this matter in consultation with officers of the local mobile antiaircraft artillery units.

2. **Project No. 136, Ordnance Equipment Chart for Antiaircraft Artillery Regiment.**—This chart is being studied by the Board. It appears that the machine gun will replace the automatic rifle for antiaircraft work.

3. **Project No. 138, Review of Training Regulations, "Antiaircraft Machine Gun Marksmanship"**.—These regulations are being studied by the Board.

4. **Project No. 140, Final Report, Service Test of Caterpillar Adapters for 8-inch Howitzer Mark VIII-1/2.**—This report is being studied by the Board.

B. PROJECTS PREVIOUSLY SUBMITTED ON WHICH WORK HAS BEEN ACCOMPLISHED.

1. **Project No. 78.—Method for Obtaining Deflections from Direction Prediction Boards, (Haw Deflection Computing Method).** The proceedings of the Board on this project were as follows:

a. **Conclusions.**—(1) This device, or method, incorporated as a part of the direction prediction board, readily accomplishes the operation of deflection conversions, and is preferable, both from the point of view of speed and of simplicity of plotting room operation, to a separate device for this purpose.

(2) In mobile artillery fire on floating targets, if direction prediction boards, incorporating Captain Haw's method be used, the present standard panoramic sight can be used without modification.

(3) The methods outlined are independent of the direction of the graduations on the azimuth circle of panoramic sight because the direction of the graduations on the vertical T-square of the direction prediction board can conform to the graduations on the azimuth circle of the panoramic sight which is being used.

(4) These methods require:

(a) The line of sight to be made parallel to the axis of the bore at zero setting on the azimuth circle and micrometer screw of the sight.

(b) The angular difference between the azimuth of the line gun-set-forward point and the azimuth of the line, gun-aiming point to be obtained on the direction prediction board and referred to the zero of the panoramic sight as the normal.

(c) This referred deflection to be set on the sight.

(d) The gun to be traversed until the line of sight is on the aiming point.

(5) A modification of the present panoramic sight is desirable to permit predictions on the plotting board and the conclusions above should not be construed as eliminating this desirability.

b. *Recommendations.*—(1) That a mimeographed or printed copy of Captain Haw's descriptions (together with conclusions of the Coast Artillery Board) and the action of the Chief of Coast Artillery be sent to each mobile artillery organization in the Coast Artillery.

(2) That the general sense of Captain Haw's descriptions be included in that part of Training Regulations on Gunnery which will refer, presumably, to the use of Range and Direction Prediction Boards.

(3) That Captain Joseph C. Haw, C. A. C., be commended for his professional zeal, in that he has made a valuable contribution to direction prediction boards for their use by mobile artillery in fire on moving targets.

A detailed description of Captain Haw's device will be published later in the COAST ARTILLERY JOURNAL. In the meantime, mobile artillery organizations desiring a complete description of this device can obtain same from the Coast Artillery Board.

2. Project No. 111.—Fire Control Telephone Systems for Fixed and Mobile Coast Artillery. The proceedings of the Coast Artillery Board on this project were as follows:

a. *Conclusions.*—(1) The system of fire control communications outlined in Coast Artillery Drill Regulations and Signal Corps Manual No. 8, and at present standard, is satisfactory except as noted elsewhere in this paper.

(2) The following commanders should be provided with base lines and communications pertaining thereto under their respective separate tactical and physical control.

(a) Each battery commander

(b) Each fire commander

(c) Each fort commander.

(3) The communication system should permit any two suitable observing stations within a fort command being used as a base line.

(4) Provision should be made such that any battery may obtain data from any base line, within the fort command, that covers its field of fire.

(5) When acting independently, mobile coast artillery will establish fort, fire, and battery commands corresponding in organization to those of the fixed defenses. When acting in conjunction with the fixed defenses they will usually establish only fire and battery commands and but rarely fort commands.

Their communication system conforms tactically to that of the fixed defenses.

(6) The present coast artillery communication system does not meet the needs of the fixed and mobile coast artillery as outlined above and is below commercial standards in the matter of communication efficiency, thus rendering it unsuitable for the long range armament.

(8) Common battery supply through No. 19 conductor cable is not suitable for some of the longer lines.

Some commercial companies have adopted a distance of five miles from the central battery as the distance not to be exceeded for this type of conductor. This results in a possible length of line, phone to phone, of ten miles.

(9) The coast artillery fire control telephones receive much harder usage than commercial phones, frequently being used continuously for several hours.

(10) The difficulty encountered on long lines could be overcome in either of the following ways:

(a) By adoption of a standard local battery system (with such added features as may be desirable) throughout the Coast Artillery.

(b) By using separate current supply at the most distant stations with phones of either the local or common battery type.

b. *Recommendations.*—(1) It is recommended that the Signal Corps be called upon to design and submit for test the essential elements of one or more sample fire control systems meeting the conditions set forth under "Conclusions" above, and as far as practicable in conformity with opinions expressed under the heading "Discussion" below. In the design of such a system (or systems), it should be borne in mind that it should not merely be better than the present system but must at least meet present commercial standards. The Signal Corps should also submit plans for remodelling our present system together with an estimate of the cost involved. The estimate of cost should be sufficiently detailed to permit the determination of a policy for remodelling.

The sample communication system should include a time interval system suitable for operation on No. 19 gauge lines up to thirty miles in length.

c. *Discussion.*—Conditions to be met by Coast Artillery Communication Systems.

(1) It is assumed that the present standard system of fire control communications at Coast Artillery posts and the conditions under which they are operated are understood by all concerned in this discussion.

(2) The increase in range of our seacoast guns from the prewar value of 12,000 yards to the present range of 44,000 yards necessitates longer fire control communication lines. These lines will hereafter frequently be twenty miles long from telephone to telephone, and in some exceptional cases, they may be thirty miles long. Ninety percent of the lines will be less than six miles long from telephone to telephone.

It is to be noted that observers at a distance of one or two miles apart may be connected by 15 or 20 miles of line. It is very desirable that observers be able to converse clearly with each other, but it is not absolutely essential where the length of line is such as to render the cost of such provision excessive.

(3) The recent adoption of the Cloke Plotting Board for Coast Artillery use renders it practicable for any battery to use data from any number of suitable base lines.

(4) Each battery should have as an integral part of its system and under its direct control sufficient number of base lines to enable it to cover effectively its most important fire areas. While this statement is made largely as a matter of experience and while there is not absolutely conclusive proof that such an arrangement is the best, it obviously results in a unity of command that is desirable.

If the battery commander is entirely dependent on some other agency for fire control data there is an undesirable division of responsibility.

(5) It is desirable for fort commanders and fire commanders to have under their control certain base lines covering the entire field of fire pertaining to their commands, particularly at long range.

(6) To obtain the maximum usefulness from guns and fire control equipment, it is desirable that provision be made such that any battery may receive data from any base line covering its field of fire.

(7) As that station best suited for spotting will generally be also best suited for tracking, economy and efficiency will usually result from locating a spotting instrument in each observing station. This renders it desirable to have three telephone lines to each observing station (observer's, reader's, and spotter's lines).

(8) In special cases it will be desirable to provide for interchange of base

lines between fort commands. This is obvious from the fact that fort commands are merely arbitrary divisions of coast defense commands, made to conform as closely as practicable with natural divisions.

(9) Railway and tractor artillery are integral parts of the Coast Artillery.—The existence of this mobile element of coast defense makes it necessary to re-design and rearrange the Coast Artillery system so that mobile batteries may be given base line data, ranges, or base lines immediately upon their arrival in fixed defenses. This does not, and should not preclude the establishment by such units of their own field of fire control systems under their own direct control. Such systems, however, when established should be available when needed for use by the batteries of the fixed defenses.

(10) Railway and tractor artillery fire control communication systems differ from those of the fixed defenses only as they are affected by the mobility of these types of artillery.

(11) Railway artillery fire control communication systems are not materially limited by considerations of weight except that line material must be of only moderate weight in order that fire control systems can be rapidly established, especially when this artillery is assigned to coast defense duty outside of the fixed defenses.

A railway battery employed on the seacoast may establish as many as four base end stations.

(12) Tractor artillery fire control communication systems are limited to some extent by considerations of weight in transport inasmuch as the transportation is by truck. Line material should be as light as practicable.

A seacoast tractor battery will usually establish two or three base end stations one of which will usually be a self-contained range finder.

(13) Tractor and railway artillery can operate in emergency with one telephone line to each base end station, but when positions are occupied permanently, provision should be made such that three lines may be carried to each station (observer's, reader's, and spotter's lines).

(14) Battalion commanders of railway and tractor artillery usually will act as fire commanders for their battalions and will have base lines under their control. Provision should be made also for a fort command base line for each regiment.

(15) Provision should be made for interchange of base lines, base line data, and ranges with the fixed defenses and between the elements of the railway and tractor units.

(16) The present system of coast artillery communications has been, until recently, fairly satisfactory, as communication lines generally have been short and well insulated, and as the Whistler-Hearn Plotting board did not lend itself to shifting of base lines.

(17) For future requirements, the present system is deficient in the following:

(a) The transmitters and receivers are inefficient, being only about 2/3 as good as standard commercial equipment, according to Signal Corps tests.

(b) The transmitter current is excessive on short lines and not enough on long lines.

(c) No provision is made for switching of lines.

(d) Batteries do not generally have any communication system entirely under their control. In some cases power is provided from fire command stations, and in other cases there is a mixture of power supply.

(e) The present head harness is rather heavy, hot, and cumbersome.

(f) In many cases, one shot, falling in or near a control battery station would destroy the communications for an entire fire or fort command.

(g) The time interval system at present in use will not operate satisfactorily on long lines or lines of high resistance.

(h) The time interval system at present standard is quite satisfactory on short lines in the fixed defenses.

(i) The limit of operation of one bell over one line appears to be 5 miles. On shorter lines two or more bells may be operated in parallel. For longer distances two or more lines per T. I. bell must be used.

(j) The regular timing and interrupting apparatus is satisfactory for the fixed defenses and for railway artillery.

The timer and interrupter reported on in Coast Artillery Board project No. 56 is satisfactory for tractor artillery or railway artillery.

(k) The use of bell signals is satisfactory in most cases in the fixed defenses. For long lines in the fixed defenses and for railway and tractor artillery it is most convenient to introduce a buzzer tone in the telephone system by induction, or to provide a howler in place of a T. I. bell.

(l) Additional windings on the telephone induction coils are not recommended. Two types of transformers should be supplied, each with several taps. One type should be designed to have its secondary in series with an ordinary telephone line, while the other type should be arranged to operate a telephone receiver as a howler. It may be practical to design one transformer for both purposes.

In connection with the above project considerable information was obtained from Signal Corps officers and officers of the mobile artillery units at Fort Eustis.

3. Project No. 120.—Ammunition for Antiaircraft Guns to Serve as Targets. The Coast Artillery Board reported on this project as follows:

a. It is the opinion of the Coast Artillery Board that the High Explosive shell burst is no more suitable as a target for antiaircraft artillery firing than shrapnel burst. There is practically no difference in color of the burst when fired away from the sun. The burst of the shrapnel hangs together for a longer time which makes it superior to the High Explosive burst.

b. It is thought that a balloon target will be more satisfactory and it is therefore recommended that no further steps be taken at this time to obtain an ammunition with distinctive burst.

5. Project No. 121. Antiaircraft Targets.—The Coast Artillery Board reported on this project as follows:

a. Experiments conducted with a cluster of 9-inch balloons indicate that it makes a suitable substitute for the 6-foot barrage balloon. A cluster of 5 balloons was found to be more satisfactory than the cluster of 4 balloons as its flight gave a more uniform course.

b. The 6-inch meteo-balloons probably will be a satisfactory substitute for the 9-inch balloon but some of these balloons should be furnished for test.

c. It is believed that a universal target having the following specifications should be adopted for .30 caliber machine gun, .50 caliber machine gun and antiaircraft artillery:

A balloon that inflates to about 24"; that will hold hydrogen up to 2500 yards in altitude; that is a distinctive white in color and has a good reflecting surface in a searchlight beam and that the target contain a cluster of at least 5 of these balloons.

It is recommended that balloons of this type be furnished for test.

d. There are no 24-inch balloons on hand but it is thought a balloon of this size in clusters of 5 would make a suitable target.

THE BULLETIN BOARD



OBVERSE

REVERSE

THE COAST ARTILLERY—MARINE CORPS TROPHY

The Coast Artillery Trophies

The members of the Coast Artillery Corps, officers and soldiers, who have contributed so generously to the Trophy Fund will be pleased to see the photo-

graphs of two artistic pieces in sterling silver which have just been completed by the Bailey Banks and Biddle Company of Philadelphia.

The engraving on the trophy Shown on Page 184 reads—"Presented by the Officers and Enlisted Men of the Coast Artillery Corps, United States Army, to the United States Marine Corps, in appreciation of the assistance rendered by members of the Marine Corps Rifle Team to the members of the Coast Artillery Corps



OBVERSE

THE COAST ARTILLERY RIFLE TROPHY

REVERSE

Rifle Team, in training for the National Rifle Matches during the years 1919 to 1922, inclusive. To be awarded each year to the Marine Officer or Enlisted Man making the highest score in the National Individual Rifle Match."

The Coast Artillery Rifle Trophy is "Presented by the Officers and Enlisted Men of the Coast Artillery Corps, United States Army. To be awarded each year to the Coast Artilleryman making the highest score in the President's Match."

Harbor Defense Days at Fort Hancock

By Lieut. Frank C. McConnell, C. A. C.

On Saturday, May 19, and Saturday, June 23, 1923, at Fort Hancock, N. J., occurred events unique in the history of the Coast Defenses of Sandy Hook. These were the dates of the Harbor Defense Days at Fort Hancock. As is indicated by their names, these Days were devoted to the demonstration of modern methods of training and practice in the art of Harbor Defense. Witnesses of the demonstrations were National Guard and Reserve Officers from New Jersey and New York, their wives and friends.

The first Day was given over to demonstrations of present day methods of training and examples of drills. The three hundred and eighty five guests arrived on the Quartermaster steamer *General Johnston*, about 1:30 P. M., after an hour and a half ride from New York City. The guests assembled in the War Department Theater after disembarking and were greeted by Brigadier General Hugh A. Drum, Coast Artillery District Commander, and Colonel James F. Brady, Coast Defense Commander. Following the talks of welcome, Lt. Col. Harry Lee Watson delivered a forceful lecture on "Positive Methods of Coast Defense" as exemplified by present War Department policies.

Following this assembly, the guests proceeded to the post parade ground. There the garrison staged ceremonies of Escort to the Color and Presentation of Recruits to the Color, ending in a review of the troops by Gen. Drum.

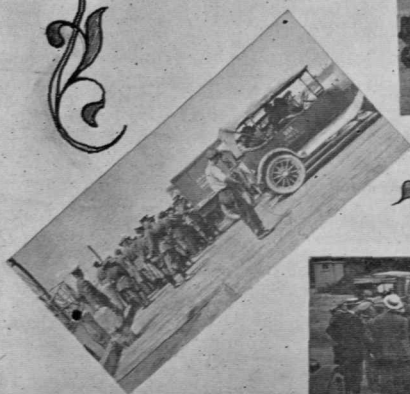
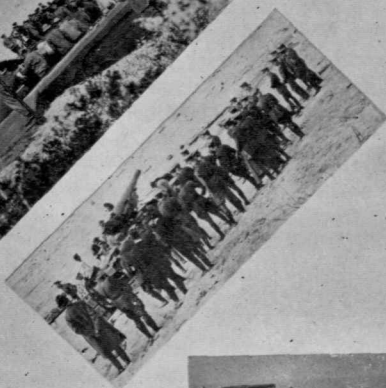
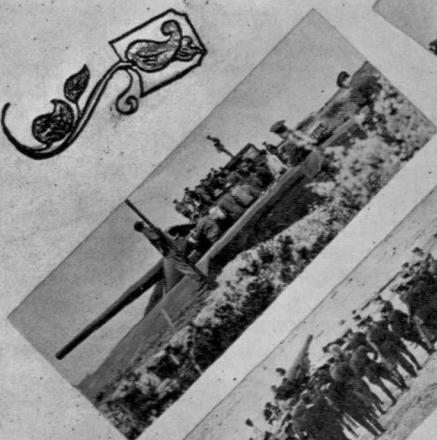
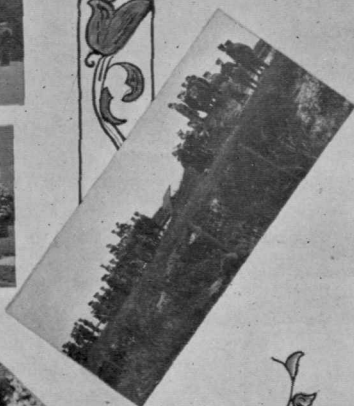
The guest party was then broken up into the ladies' section, which was taken to the Officers Club, and the Officers' section, for which motor transportation was available to carry it to the various points of demonstration. The ladies of the party, numbering about one hundred and twenty five, were entertained at the Club by the ladies of the Post with a tea, while Officers were witnessing the artillery demonstrations. After the ceremonies on the parade ground the visitors were taken through the model barracks of the 76th Company, C. A. C., on a tour of inspection, giving the troops time to man their various batteries and stations.

A firing problem by Antiaircraft battery "B", Capt. A. M. Jackson, commanding, and manned by the 136th Co., C. A. C., was next in the line of march. The problem was firing at bursts and was executed with precision and promptness. The next stop was at the Mine Command. This problem was the destruction of a target towed across the mine field, executed under the direction of Captain Napoleon Boudreau, Mine Commander. A mine field had been planted the previous day and everything was in readiness for firing when the guests arrived. The tug towed a target across the field and the exploding mine tilted the target in the water. At the same time a battery of 155-mm G. P. F.'s, commanded by Capt. John T. Lewis and manned by the 76th Company, C. A. C., opened fire on the same target, with sub-caliber ammunition.

The next demonstration was executed by the 137th Company, C. A. C., at *Battery Peck*, commanded by Lieut. Frank C. McConnell. It was a demonstration of the bracketing method of fire adjustment executed with a six-inch rapid fire battery and sub-caliber ammunition.

The Coast Defense Commander's station, Message center, and Fort Command station were the next center of interest. This group solved a theoretical coast defense problem involving the defense of New York City from attack by an enemy fleet and landing party. The solution of the problem was explained to the guests by Colonel Brady and Lt. Colonel Watson, and the guests were promised that the problem would be worked out in practice the next Harbor Defense Day on June 23, weather permitting.

The last number on the program before dinner was a sub-caliber firing at *Battery Kingman*, a twelve-inch long range battery, manned by the 136th Company,



C. A. C., and commanded by Captain Albert M. Jackson. At the completion of this demonstration the guests were transported back to the Officers' Club, arriving at seven o'clock, the pre-arranged hour for supper, all demonstrations having been executed on a time schedule.

A buffet supper was served all guests and the officers and ladies of the post for seventy-five cents each. After the supper hour the gathering again assembled on the parade ground to witness a demonstration of combined gymnastics and calisthenics by the entire garrison.

This number completed the program of demonstrations for the first Day and the remainder of the evening was spent in dancing at the Officers' Club, preceded by a reception. At eleven o'clock the party ended and the guests departed by government boat for New York City.

SECOND HARBOR DEFENSE DAY

The Second Harbor Defense Day at Fort Hancock was planned as a series of service practices to demonstrate the end attained by the period of preliminary training. Following the first Day came a succession of mists, fogs, and hazy weather; poor visibility in general was the rule. So it was with apprehension that the principals concerned looked forward to the dawn of June 23rd. But the day broke fair and visibility was much better than previous days, so it was decided to go ahead with the practices as scheduled.

The one hundred and eighty-five visiting officers came down the harbor by government boat, arriving at Fort Hancock about 11:30 A.M. They were greeted at the War Department Theater by Brigadier General Drum and Colonel Brady, with brief speeches of welcome. Lt. Colonel Edwards, Fort Commander, then explained the problems to be fired during the afternoon. About this time Major General Bullard, Corps Area Commander, arrived at the assembly. He made a brief speech and the meeting adjourned to have lunch at the Officers' Club.

After lunch the visitors were taken to the three-inch fixed antiaircraft battery which was to fire the first problem of the afternoon. The battery was manned by the 136th Company, C. A. C., and commanded by Captain A. M. Jackson. The airplane target was in the form of a long sack which filled with air when towed behind the plane.

The next practice was by 155 mm G. P. F. battery, manned by the 76th company, C. A. C., and commanded by Captain John T. Lewis. They fired at a towed target six thousand yards off shore. This was the initial practice fired by this battery, as it was received at the post only last spring.

The third and concluding practice on the schedule was the solution of the combined Coast Defense and Fort Command problem, explained in theory the first Day. It was to be executed by Batteries *Kingman* and *Peck*, a twelve-inch long range battery and a six-inch rapid fire battery, respectively. Two towed targets were sent out to represent the enemy fleet.

By this time the weather had changed and the visibility became so poor that it was decided to postpone the long range practice, but to continue with the six-inch battery practice. But by the time the visitors had gathered at Battery *Peck* a sudden rain storm blew up at sea and the target was obscured from the observers, so after three shots were fired the practice was called off.

The guests ended their Day with a tour of inspection of the Mine Casemate, mine storehouses and loading room, and the boat-houses. This tour ended at the dock about 5:00 P. M., where the party boarded their boat and sailed for New York City, supper being served on the homeward journey.

Perhaps the outstanding feature of the practices held was the perfect liaison maintained between the Message Center and the batteries firing and between the Center and the airplanes used for observing the fire.